Concrete

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Why Stop Now?

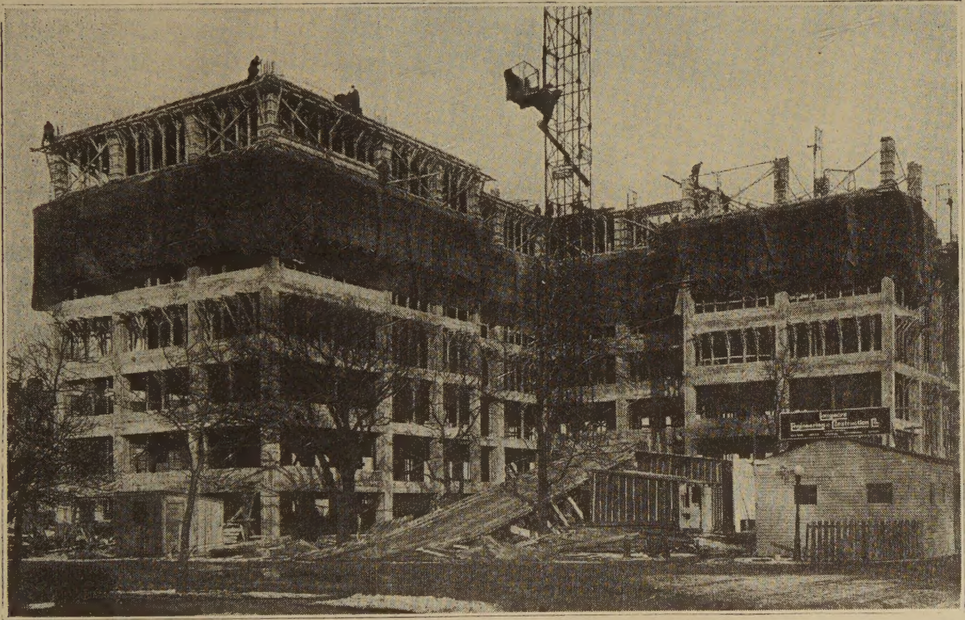
—There's Profit in the Jobs Built Between Now and Next Spring!

SOON after the first of this year, one of New York's largest department stores found itself with increased business, warehouses filled, a large stock of spring goods moving in, and summer goods, such as canoes, wicker furniture, etc., ordered for delivery in April. Immediate expansion of the warehouse was necessary. But it was winter and the new space had to be available by April 15th!

Not many years ago such a situation would have daunted the most intrepid. People didn't build seven-story additions to warehouses in the winter. The concrete might freeze. The cost would be too great. And where would you find a contractor who could be depended upon to do such a job under those conditions? Even under the most favorable weather conditions, the job would be a race against time. It wouldn't require an expert to give a flock of reasons why the job simply could not be done.

But it *was* done. And it was finished on schedule. And the concrete was above the required quality. And the contractor demonstrated that even under cold weather conditions it is economical to apply the principles of quality control to the making of concrete. And there were some real savings effected.

It is not the purpose of this article to go into a detailed description of this particular job. All the facts regarding it were published in the leading article of the July issue. It is simply referred to as one of many successful winter jobs that prove beyond the shadow of a doubt that concrete construction can be carried on economically, speedily and satisfactorily in all kinds of weather.



One of the steadily increasing number of winter jobs. Many concretors have found it decidedly profitable to operate on a twelve-month instead of an eight-month basis

The point is this. Here was a contractor who refused to let the weather limit him to a construction season of only seven months or so, when he could use the full twelve months of the year. And he is only one of a steadily growing number who are progressive enough to cash in on this economically sound development.

When—as was the case last year—one million American workmen are thrown out of work and three-quarters of a billion dollars are kept out of circulation, somebody is going to suffer. And somebody is going to pay the bill.

Building is our second largest industry. For three successive years our annual building bills have exceeded a total of five billion dollars. When an industry of this size quits for a spell, what happens? Let's see.

Figures compiled by governmental and private authorities disclose the important fact that the average monthly volume of construction activity throughout the country during the months of November, December, January and February is only 5 per cent of the annual total. It has been estimated that the average monthly decrease in construction during the winter amounts to $175,000,000. That loss is distributed many ways. The contractor, the building material manufacturer and dealer, the laborer and therefore the butcher and the baker, all lose.

Before we look at this question from the contractor's side, let's first see what it means to the owner for whom the building is being constructed. After all, he is the king pin in the problem, because if he does not benefit, a very important reason for winter construction is gone.

Here is an actual experience that will sum up the situation from the owner's point of view. It is typical of any number of other experiences. During the winter of 1925-'26, the Shelby Shoe Company needed new quarters—at once. So they built a new five-story reinforced concrete factory at Ironton, Ohio. The next winter a second new factory was built, this time at Portsmouth, Ohio. Right now a third factory is under construction, with completion set for some time in April. And here is the reason for this procedure. According to Homer C. Shelby, vice-president of the company, the actual savings effected by winter construction and the earlier occupancy that it made possible amounted to the profit on 1,250,000 pairs of shoes!

When you get right down to facts, it is habit, not necessity, that is responsible for the winter building slump. Temperature has very little to do with it. Even where the winters are comparatively mild, the onset of winter brings much the same result as it does in the colder regions. It's habit. Once the contractor has tackled a winter job, he has proved the value of winter construction for himself and the next year sees him among the all-year-round bunch. It's just a matter of getting a start.

Of course, there are some extra difficulties. Concrete is made with water and water freezes in cold weather. And when concrete freezes before it hardens, there's sure to be trouble. But when you've said that, you have said pretty nearly everything that can be said against winter work. But even that is no longer a valid objection. That problem is solved with a few simple precautions. We now have equipment that will conquer the most severe weather conditions. Methods for protecting the concrete while it is hardening are well known and understood. Even under the most severe conditions, the extra cost of winter construction seldom amounts to more than 5 per cent of the investment and usually it is around 1 per cent.

This, then, is the only real objection that can be put on the "disadvantage" side of the argument from the contractor's point of view. What can be put on the "advantage" side? And will the advantages more than balance the score?

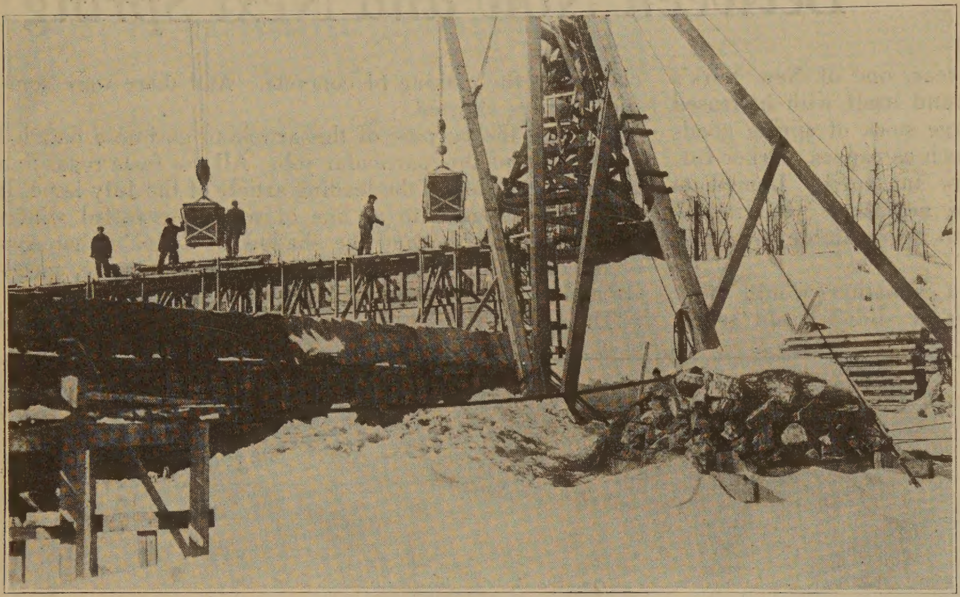
Let's see if they do. In the first place, what about overhead? If you will put down the figure that your books show as overhead for the year and divide it by eight, you have the monthly overhead cost that must be charged against your summer jobs. Now, if you divide that figure by twelve and spread it over a full year's activities, each job will have to carry a much smaller proportion. Your figures will show a neat saving there. Maybe it will be more than enough in itself to balance that extra winter construction cost.

Now put down the profit that you have made during an eight months' construction period. Increase it by the additional profit you could make during the extra four months that you have added to your productive time.

It is difficult to put down in black and white many of the other indirect savings that result from winter operation. The dollars and cents value of keeping an efficient, loyal organization intact is hard to determine. But it is a very real item. You can start off in the spring with the same trained organization and be way ahead of the fellow who first has to get his gang together and then spend time and money getting them whipped into a smoothly working organization. It's logical, too, that you can have the pick of the men available, because an all-year job is more attractive to the laborer than a part time job.

This, of course, is not by any means a complete summary of the reasons for and against winter construction. But it is a rough picture of what some contractors who have gotten into the winter construction game have found. Those who have tried it *know* that when you balance up, the "advantages" have it by a landslide.

Will this winter see you on the job?



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Winter construction does require extra precautions, but the additional cost is more than made up by the advantages gained

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Concrete Products vs. Cold Weather

Some Pre-Ringside Observations of Methods That Concrete Products Manufacturers Are Using to Keep Their Business Going the Year Round

By "SPEC" COLLINS

ON a bleak, raw November day four years ago the writer drove up to a concrete products plant looked upon as the leader in its particular community. The plant seemed deserted—only a couple of men puttering around at odds and ends. In the office I found the owner toasting his shins. He'd just concluded that momentous task the day before of "shutting down for the winter." Just the other day I had occasion to visit this same plant. The picture was entirely different. A goodly stock of block was piled in the yard, but inside the plant the tampers pounded with a vengeance.

"Goin' to close down this winter?" I queried as a starter for the conversation. "Nope, not this year," came back the answer. "I haven't closed down for the past two winters and chances are that I won't again. Of course I haven't run full blast or anything like that, but I've kept on a skeleton crew and had a right sizable production. I've taken on a new specialty that keeps a couple of men busy and working on blocks with a small crew gives me a chance to keep my stock as well as my crew in balance for the rush that always comes in spring. Besides that, the fact that I'm operating sort of spurs me into a little more effort along the selling line than I put out when we're shut down."

A New Attitude

The attitude of this man might be said to be typical of that taken by many progressive products manufacturers. More and more of them are breaking away from the time honored habit of closing up the plant on the first snowy day and waiting for the flowers to bloom in the spring before resuming operations. Winter operation costs more than summer —there's no getting away from that. But I believe that it's decidedly worth while. As in the instance cited above, where a skeleton organization was kept on the job, getting started on full production in the spring is a much easier matter than where a complete new crew has to be broken in. An organization that is familiar with the ins and outs of the business is a mighty valuable asset and cannot be picked up in every back yard.

Promotion by various agencies, from the Department of Commerce on down, has been responsible for an increase in winter building operations. The big cash-in that the concrete products manufacturer has made on this stimulated winter building has been in substituting his material for monolithic concrete. Many of the smaller contractors are not properly equipped for heating materials and caring for monolithic concrete during freezing weather, yet have a desire to carry on and keep their organizations busy during this period of the year. Into the picture steps the concrete products manufacturer and shows the contractor that by using concrete masonry in various combinations the work can be carried on with very little outlay for extra equipment and a profit made on the job.

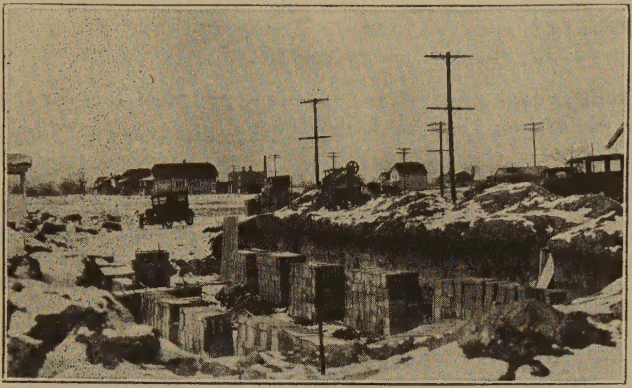
But to supply these materials a constant balancing and replenishing of stock is necessary. So let's forget about the contractor and move on to the concrete products manufacturer and some of the problems he must face in this battle of Con Crete vs. Kid Winter.

Winter Curing Needs

The first thing on the program for efficient winter operation is some sort of a curing plant. It is quite surprising how cheaply steam curing may be had and on the other hand how amazing the number of plants throughout the country who have no means of curing except a length or two of garden hose. A second hand boiler, low pressure, can usually be picked up at a low price from firms making a specialty of handling this class of material. And the piping is not especially expensive.

Here is a builder who gave some block manufacturer a winter order. Would you be able to supply his needs?

A word about buying boilers. Do not take it for granted that the boiler is in good shape, but demand a certificate of inspection from the state or local boiler inspector before you pay down any money. Little need be said about the design of curing rooms. The size depends on the output of the plant. Even though you have blueprint plans of a curing room to follow watch your masons. concrete men and carpenters to see that they get as tight a job as possible. I cannot help but think of one day last winter when I approached the newly constructed curing room of one of my friends. I found enough steam pouring out the crevices and cracks around his doors to adequately care for the needs of an average sized plant. A 15 h. p. boiler should heat a curing room of 10,000 cu. ft. capacity to 100 deg. when the outside temperature is at zero. But if you neglect to make your curing room tight you'll have difficulty in reaching that temperature with a 50 h. p. boiler. Out in Kansas I know one manufacturer who, during the winter months, covers the tops of his curing rooms with hay, weighting it down with blocks. He contends that this covering saves him no small amount of heat and is a profitable procedure.



Concrete block can be made economically in winter. It's surprising, too, how many can be sold during cold weather

Heating Aggregates

While we're on the subject of steam let's talk about its use in heating the aggregate you're going to use this winter. With the growing tendency toward overhead bins for aggregate storage there has been quite a bit of experimenting done with methods for keeping the sand and stone in these bins free from frost and in usable shape. Just a short time ago one of the leading manufacturers of bins told me that he had arrived at the conclusion that a small jet of steam playing into the bin at the bottom was the solution to this problem. This man has built a number of bins with coils for heating fastened to the inside, but he tells me that these have not proven satisfactory. The heat seems to penetrate but a short distance from these coils, while the live steam gradually works its way entirely through the aggregate, which in turn seems to retain this heat for a surprisingly long time. If aggregate is stored on the ground it should be protected by a covering of some sort. A steam hose run into the pile will, in a very short time, result in an aggregate excellent for concrete and free from all frozen lumps.

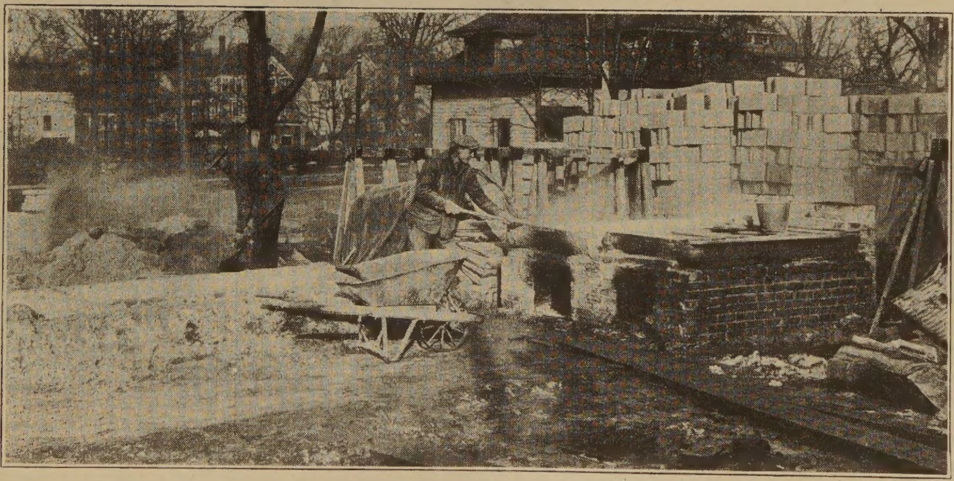
Many manufacturers who, during the warmer months, buy their aggregate by the car get it by truck during the winter. This truck delivered aggregate usually comes from a stockpile and is delivered so quickly that it has no chance to freeze on the way. While its initial cost is greater than by car, there is less grief in handling and it requires less preparation for use. Where it is necessary to buy aggregate by the car, or where it is more convenient to do so, the steam hose can again be brought into action. It can be spotted at various places in the car for about two-hour intervals until sufficient aggregate is loosened to make unloading a matter as easy as in summer. A tarpaulin spread over the car during this process will be found to be a great heat conserver.

Where no steam is available for heating aggregate stored on the ground an old section of smokestack or iron culvert is often used for heating purposes. Simply pile the aggregate around and on top of it and keep a good fire going. This method is rather expensive and hazardous, but it fills the bill. Just one more thing about removing frozen aggregate from cars. Unless you are familiar with dynamite don't attempt to use it. I'll never forget the experience of a friend of mine had some winters ago. His first and last attempt to use dynamite were one and the same—the dynamite blew down instead of up and as result he had a pretty bill to pay the railroad company for replacing the bottom of the car in which he conducted his experiment.

Drying Off the Block

A wrinkle developed by one of the manufacturers in this vicinity may overcome one objection to steam curing in winter—that of the block freezing as soon as placed outside. He has a unit heater rigged in front of a blower and before the products are taken from the curing room this apparatus is backed up, turned on and given an opportunity to remove all surface moisture. This so-called drying off of the units does away with freezing and sticking together. He tells me that it also results in a more uniform looking product in the yard. Proper curing is mighty essential in winter and a poorly cured block placed in the yard at winter temperature is usually just as poorly cured when removed in the spring. This results in broken corners and edges and an undue amount of breakage.

About stockpiling concrete block in the winter time.

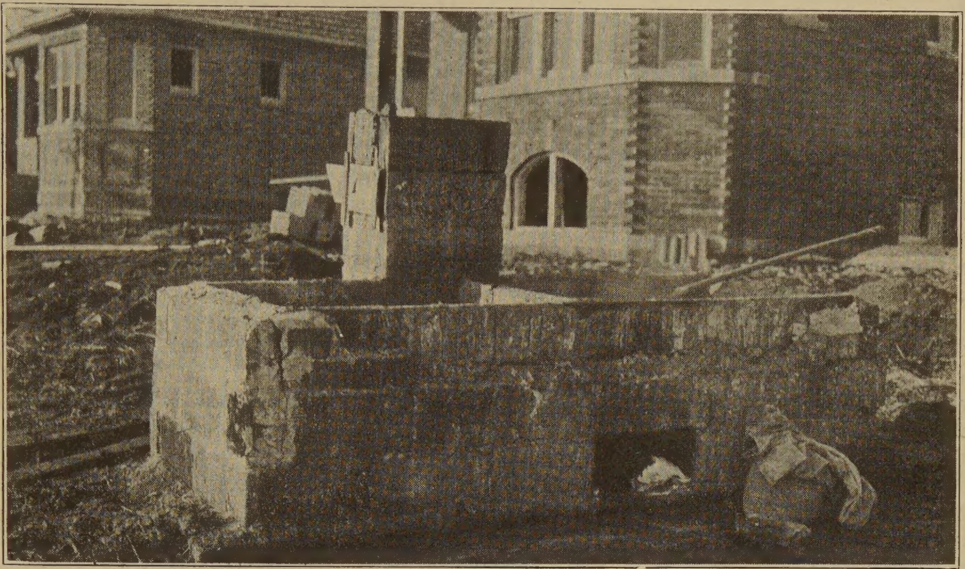


When concrete products manufacturers make one try at winter operation, they usually continue it as good business

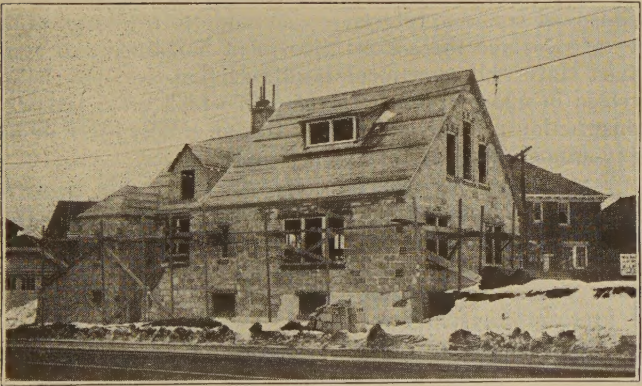
Many manufacturers pile the top two rows of blocks on their side, staggering the joints in these last rows. This method of piling is helpful in preventing snow, which later thaws and freezes, from sifting down toward the bottom of the pile. This method of piling will take slightly more labor than the customary method but is a time and money saver when it comes to taking the blocks from the pile.

Cold Weather Manufacturing Methods

During the past few years quite a few manufacturers of concrete block have been experimenting with calcium chloride as an accelerator during the winter months. So satisfactory has it proven that they have continued its use during the summer months. It will take a bit of experimenting to determine the exact amount to use, but from personal observation I have found that between one and a half to two and a half pounds per bag of cement can be safely recommended. It is quite surprising the effect this has on the time of set during cold weather and the resultant firm edges and corners on the blocks. One manufacturer I know tells me that the saving on breakage alone more than pays for the calcium chloride he uses. Here is something more products manufacturers should look into.



An arrangement for heating the mortar used in concrete block construction during cold weather



An idle plant gives the other fellow a chance to get your share of the winter sales

There is a tendency during cold weather for blocks to stick to the face plate of the machine. This is especially true when rock faced blocks are being made and results in an objectionable looking and unsalable product. Heating the face plate will eliminate much of this. Some machines come with the face plate already equipped with an electric grid which can be hooked into the light socket. One man I know has rigged up his own heating elements by making use of grids from ordinary electric irons. Electrical heating of the face plate is probably the most satisfactory method. Some products manufacturers have had gas piped into their plants and run a small jet directly back of the face plate. This jet should have a large enough spread to heat the plate uniformly. Gasoline torches have been used to some extent. These can be picked up cheaply and seem to serve the purpose in first class shape.

So if we're going to spread our overhead in a rather straight line over 12 months of the year, that 12 months must be those of continuous operation. After one try at winter operation most plants continue it as a good business venture. Idleness during the winter is mighty expensive and it costs a lot of money to perfect a smooth running organization every spring. Right now is the time to check over the plant and get ready for winter. It's not too late and it's never too early.

Coming Conventions

American Concrete Institute—February 12th to 14th, 1929. Twenty-fifth annual convention, at the Book-Cadillac Hotel, Detroit, Mich.

American Road Builders Association—January 14th to 19th, 1929. Convention and road show, at the Cleveland Public Auditorium, Cleveland, Ohio.

Nebraska Concrete Products Association—January 24th. Annual meeting, at the Lincoln Hotel, Lincoln, Nebr.

Wisconsin Concrete Products Association—January 10th and 11th. Annual convention at the Hotel Plankinton, Milwaukee.

Reinforcing Men Seek to Extend Uses of Concrete

Concrete Reinforcing Steel Institute Meets to Discuss Trends in Use of Reinforced Concrete

WHEN manufacturers who supply equipment and materials used in reinforced concrete construction meet at their conventions to discuss the problems confronting them, it is natural that a large portion of the discussions will refer to matters of vital interest to the user of these materials also. So it was at the semi-annual meeting of the Concrete Reinforcing Steel Institute, held at the Buckwood Inn, Shawnee-on-Delaware, Pa., October 1st to 3rd, with an attendance exceeding by 50 per cent any previous meeting in the history of the Institute.

In this buyers' market of today, industry must consider first of all the wishes and conveniences of the users of the materials it supplies. The reinforcing steel industry, through its efforts in the standardization of reinforcing bars, and metal forms, its activity in the promotion of the new Joint Building Code, its promotional activities in the interests of reinforced concrete construction and its alert search for new markets for the concretor, is working in the interests of the users of its products and is thus enlarging its own field. That this is true is shown in the following quotation from the president's semi-annual address: "We have seen signs of a wider market for reinforcing steel in the information contained in our composite tonnage reports which show that our members during the first half of 1928 increased their sales 11.6 per cent over 1927 and 7 per cent over 1926, while shipments were 15.5 per cent higher than in 1927 and 5.5 per cent higher than in 1926."

Standardization Work

One of the first efforts of the Institute for standardization was its campaign for the adoption of Intermediate Grade as the single standard for new billet reinforcement. Chairman A. E. Lindau of the committee on Steel and Standard Sizes reported at this meeting that the campaign was meeting with great success with the result that the members of the Institute were effecting savings through reduced stockpiles as well as giving better service from their warehouses. The report referred to the fact that nearly 100 per cent of the present mill production of reinforcing bars was in the 11 standard sizes adopted some years ago by the industry through the United States Department of Commerce. He also showed a practically complete adherence by the industry to the four standard sizes for spirals.

Another effort at simplification and standardization now under way in co-operation with the Department of Commerce has to do with steel forms for concrete ribbed floor construction. At the Biloxi, Miss., meeting of the Institute last March a conference was held with the Division of Simplified Practice of the Department of Commerce in an effort to standardize form dimensions for concrete ribbed floor construction. At that meeting a series of recommendations were made which were to be adopted if and when approved by the industry. The following list of stock sizes and dimensions were recommended at Biloxi:

Width of standard forms in in.	Length of tapers, in.	Total contraction, in.	Depth of all forms, in.	Widths of special filler forms, in.
20	36	4	6, 8, 10, 12 & 14	10 & 15
30	36	6	6, 8, 10, 12 & 14	(No tapers)

As these provisions were not acceptable to the required number of manufacturers, the subject was again brought up for discussion at the Shawnee meeting in an effort to arrive at a recommendation that would be acceptable. After an extended discussion, a new recommendation was approved, subject to the usual referendum of the Department of Commerce. The new recommendations follow:

Width of standard forms in in.	Depths of all forms, in.*	Widths of special filler forms, in.†
20	6, 8, 10, 12, 14	10 & 15
30	6, 8, 10, 12, 14	12 & 16

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*Depth is interpreted to mean the vertical distance from the under side of the concrete slab above the center of the form to the bottom of the concrete joist.

†To be used as specials for fillers only.

The new recommendations, which eliminate the provisions for taper and add two more filler widths, 12 and 16 in., will be published and submitted for approval by the industry.

Unusual Construction Jobs

An illustrated symposium on unusual construction jobs occupied a portion of the Tuesday morning session. During this symposium Louis Metz of the Concrete Engineering Co., of Omaha, described the recent addition to the Plains Hotel at Cheyenne, Wyo., and the Haskel Soap Co. building at Omaha. Both of these jobs were redesigned from wood construction into reinforced concrete.

Another subject covered in this symposium was concrete floors for residential buildings. W. J. Holliday of Indianapolis told of the construction of several residences in his city in which steel frames and reinforced concrete floors were used. The symposium was concluded by A. E. Lindau of Chicago, with a number of lantern slides illustrating some of the tall reinforced concrete apartment buildings that have recently been erected in Chicago.

In a discussion of possible extension of the market for reinforced concrete reference was made to the large number of two- and three-story apartment buildings and combined store and apartment buildings that are now being erected in many of our cities and in which other types of construction are used. Commenting on this subject in his semi-annual address, President Routh said:

"I want to place especial emphasis on the big field for enlarging our market which lies before us by promoting the use of fireproof construction, particularly in residential buildings—not only in fireproof houses, but in the many apartment buildings that are *not* now being built of fireproof construction.

"We have seen a tremendous improvement in living conditions throughout our country and it would seem as though conditions had now reached the point where it should be required by law that all apartment buildings be of fireproof construction. This is now required by some cities and I feel that it should be part of our work and the assistance of every member is asked in having building codes revised to require fireproof construction in buildings of this character."

In all these efforts, the aims of the Institute are exactly in harmony with those of all concretors. The co-operation of every concrete contractor with the work of the Institute will result in enlarged opportunities for him.

Waterproofing Concrete Integrally

A Comparative Test of Well Known Commercial Methods and Materials

By J. A. MEACHAM
Specification Engineer, The H. K. Ferguson Co.

THAT certain methods of waterproofing concrete integrally may be effective against a very considerable hydrostatic head and yet have no value where the pressure is slight, has been demonstrated by a series of tests recently conducted under the research department of the H. K. Ferguson Company, engineers and builders, Cleveland, Ohio. Conversely it was found that some methods that may be absolutely relied upon to prevent the transfer of soil moisture through a basement wall are not at all satisfactory for use in concrete structures intended to hold or withstand water under pressure.

Of equal importance to the builder is the fact clearly indicated by the tests, that highly waterproof concrete can be produced at low cost without recourse to special waterproofing materials, using portland cement only. The plain portland cement concrete when of proper proportions has the added virtue of being effective for the full range of hydrostatic pressure normally expected in building construction.

For purposes of comparison the means ordinarily employed to secure integrally waterproofed concrete may be classified under four headings:

1. The use of portland cement and selected aggregates in richer and better balanced mixes.
2. Admixtures consisting of finely divided, more or less inert materials, such as lime, diatomaceous earth, etc., intended to increase the density and permeability by reducing the amount of void.
3. Special cements which may be either the product of improved methods of manufacture, or ordinary portlands treated with waterproofing compounds at the mill.
4. Chemical compounds of a definitely water-repellent nature which may result either from negative capillarity or colloidal action.

Test Methods

Representatives of each group were investigated. The amount of water absorbed and the extent of penetration was determined under a head of 65 ft. Duplicate specimens were tested with the water pressure so slight as to be negligible. The compressive strength of the concrete was recorded in all cases, giving a check on the effect of the various waterproofers upon the strength of concrete.

For the pressure test, the concrete was cast in 12-in. by 15-in. blocks having a thickness of 6 in. These were rigidly clamped to a 3-in. pipe flange directly connected with a water tank on the fourth floor of the laboratory. Special apparatus was devised to insure a water-tight connection at the block face and to maintain a uniform pressure throughout the test. See Fig. 1.

The blocks were subjected to the pressure for 24 hours, which was sufficient in most cases to cause moisture to appear on the surface opposite the flange. The increase in weight was taken as the measure of water absorbed. The extent of penetration was readily observed on the exposed face when the specimens were broken open.

For the parallel test under negligible pressure, the blocks were somewhat larger and cast with a 3½-in. by 7-in. pocket 6 in. in depth, allowing a 4-in. thickness of concrete on all sides of the pocket and 7 in. under the bottom. Fifteen hundred cubic centimeters of water were placed in the pocket in each case. To reduce the effect of evaporation to a minimum the opening was sealed over, except for a small vent, by means of glass plates set in mastic.

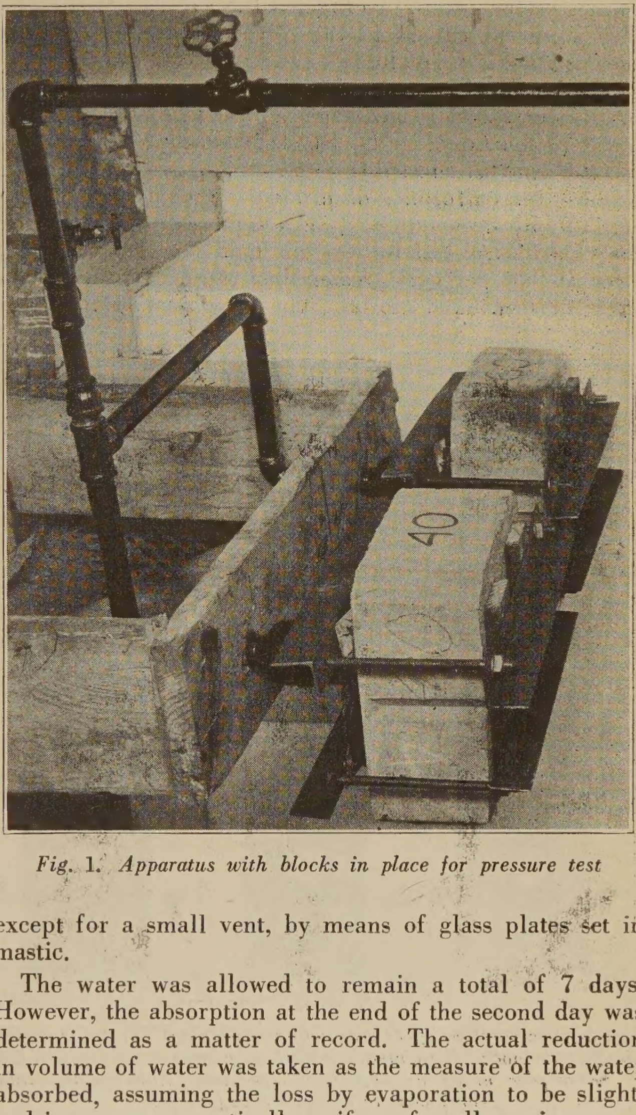

Fig. 1. Apparatus with blocks in place for pressure test

The water was allowed to remain a total of 7 days. However, the absorption at the end of the second day was determined as a matter of record. The actual reduction in volume of water was taken as the measure of the water absorbed, assuming the loss by evaporation to be slight, and in any case practically uniform for all specimens.

As in the pressure test, the extent of penetration was readily apparent when the blocks were broken open.

In this connection it will be of interest to note that the use of dyes to make the extent of penetration more apparent is neither practicable nor necessary. In preliminary tests a great number of dyes were tried out. Some experimenting was also done with chemical solutions intended to give a color indication when the face of the concrete fracture should be washed later with a prescribed reagent. None of these methods proved successful. Most of the dyes filtered out on the surface of the concrete and those that were carried past the surface did not penetrate as far as the water actually penetrated.

The penetration of the water may be quite accurately determined by inspection immediately after the fracture is made. When photographic record is desired the moistened area may be outlined with crayon or paint.

Making Test Specimens

All of the waterproofing materials were tested in concrete of identical proportions using the same brand of cement throughout, and aggregates from the same stockpiles. Seven gallons of water were used per sack of cement. The mix consisted of 1 part cement, 2 parts sand and 4 parts coarse aggregate by volume.

Waterproofing materials were incorporated strictly in accordance with manufacturers' recommendations. Where special cements were investigated for waterproofing value they were substituted in the mix in place of portland cement volume for volume.

The portland cement used was an approved standard brand that tested in all respects well within the requirements of the American Society for Testing Materials.

The sand was selected from a source particularly recommended for uniformity of product. It contained 5.3 per cent silt by decantation, gave a light yellow reaction in the colorimetric test for organic matter and developed a strength 118 per cent greater than standard Ottawa sand in 1:3 cement-sand mortar. The sieve analysis indicated a fineness modulus of 2.60 with 14.5 per cent retained on the No. 8 sieve and 66.7 per cent retained on the No. 50 sieve.

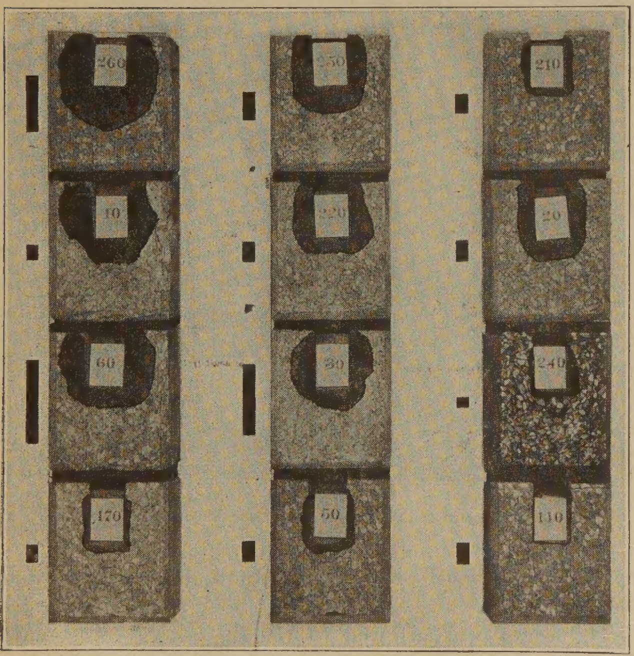

Fig. 2. Comparative effectiveness of four general groups of waterproofing methods. Dark area surrounding openings indicates extent of penetration under no appreciable pressure. Scale at left indicates penetration under 65-ft. head

The coarse aggregate consisted of crushed limestone of good quality, clean and free from dust. It graded from ¼-in. to ¾-in. with a fineness modulus of 6.83.

It was found that the extent to which the water penetrated the concrete in all cases bore a remarkably close relation to the total amount of water absorbed. For all practical purposes, therefore, the total absorption during the period of the test may be taken as the measure of the permeability of the concrete.

The amount of water absorbed by all specimens, together with their strength in compression, is recorded in the following table. The absorption is given in cubic centimeters.

Type of Waterproofer	Specimen No.	Under pressure head—65 ft.; absorption, 24 hr.	Under negligible pressure Absorp., 2 days	Absorp., 7 days	Compressive strength, lbs. per sq. in.	Slump in in.
GROUP 1						
Plain	210[1]	122	107	144	4610	1
concrete	250[2]	162	193	323	4130	1½
	260[3]	320	293	509	2630	2½
GROUP 2						
Admixtures	10[4]	90	340	585	4380	1½
in 1:2:4	20	123	164	236	4250	2½
concrete	220	121	254	373	3890	2¼
GROUP 3						
Special	30	410	247	417	3170	2¾
cements in	60	470	239	387	4260	2
1:2:4 mix	240	62	108	156	5210	2½
GROUP 4						
Chemical	40	95	233	412	4200	5
compounds	50	119	95	133	3850	3¼
1:2:4	70	94	180	283	4230	2
concrete	80	279	146	212	4350	2
	90	157	125	164	4290	2¾
	100	234	211	353	4110	4
	110	132	71	91	3210	3¼
	120	170	118	171	4080	5¾
	130	340	145	221	3330	6½
	140	239	91	119	3640	2¼
	150	191	148	222	2930	7
	160	210	111	137	3900	1¼
	170	104	102	127	2870	6½
	180	196	90	115	3660	1¾
	190	194	151	211	3360	3¾
	200	157	108	149	2900	7
	230	149	94	125	3660	6½

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[1] (1:2:3).
[2] (1:2:4).
[3] (1:3:5).
[4] Lime.

NOTE: For obvious reasons the materials tested are not identified as to the name of the manufacturer or brand.

Test Results

As a means of illustrating the degree of permeability produced by the waterproofing materials under consideration, the specimens tested under negligible pressure were photographed after being broken open at the completion of the test. The moist area indicating the extent of penetration was darkened artificially to accentuate the photographic detail. The absorption under pressure is given to scale at the left, permitting ready comparison of the materials for both extremes of pressure covered by the test. The numbers on each block correspond to the numbers used in the accompanying tables.

In Fig. 2, three specimens from each general group of waterproofers are arranged in rows across the page. Those in the top row are plain concrete (Group 1) with 1:3:5 mix at the left, 1:2:4 in the center and 1:2:3 at the right. In the second row are the admixtures, (Group 2) with lime at the left. The special cements (Group 3) compose the third row. The best of the chemical compounds (Group 4) make up the bottom row.

Fig. 3 shows all the specimens of chemical waterproofing compounds tested.

One of the special cements developed an extraordinary resistance to water under pressure, the amount absorbed being the lowest recorded. Since the penetration without pressure also was low, this particular cement stands as the most effective waterproofer tested. The results secured from the other special cements were unfavorable.

Resistance of Plain Concrete

Plain portland cement concrete showed a definite increase in waterproofing value for the richer and better proportioned mixtures. As already stated, properly proportioned concrete may be expected to give excellent results for the full range of pressures used in the experiment. The best plain concrete specimen tested can be produced at a cost of less than 50 cents per cu. yd., over the cost of the usual 1:2:4 concrete, based on Cleveland prices. In cases where the design can be worked out to take advantage of the increased strength of the better concrete, the net cost for waterproofing would be even less.

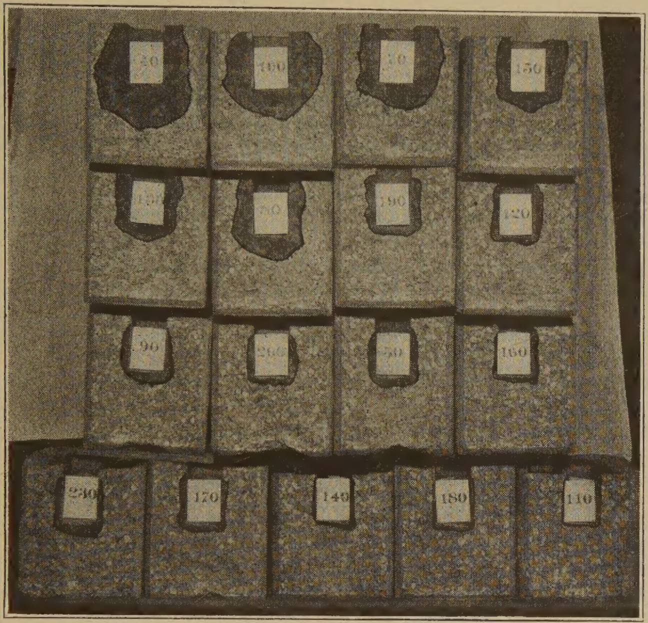

Fig. 3. Comparative effectiveness of seventeen commercial waterproofing compounds. Dark area indicates extent of penetration under no appreciable head

Of the admixtures tested, all were effective under the maximum pressure, but waterproofers of this type apparently offer very little resistance to the gradual absorption and penetration of water when the pressure is negligible. The addition of mason's hydrated lime produced a concrete having considerable resistance to high pressure, but actually increased the 7-day absorption of 1:2:4 concrete under no pressure. The failure of admixtures to withstand absorption when there is little or no pressure, casts a doubt upon their value for high pressure work, suggesting in their case a progressive penetration under pressure, whereas with definitely successful waterproofing methods, the plane of penetration is believed to recede as the concrete matures.

As a means of preventing absorption and penetration where there is little or no pressure, several of the chemical waterproofing compounds proved spectacularly effective. Of the 17 compounds tested, 7 showed less absorption than the best of all the other methods. Four of the 7 also reacted favorably under pressure, establishing a fairly good case for certain individuals of this group. It is evident, however, that a selection must be made advisedly, for no less than 8 of the 17 failed under pressure, and at least 2 showed greater absorption than plain 1:2:4 concrete when the pressure was negligible.

The following table gives for a number of the chemical compounds the mathematical average of the water absorbed by the specimens in 7 days when under no appreciable pressure. It also shows the water absorbed in 24 hours when under a hydrostatic head of 65 ft. The tabulation reflects the relative effectiveness of the several compounds over the full range of pressure to which an integral waterproofing material is likely to be subjected. Only those materials are listed from which a reasonable degree of permeability may be expected.

Specimen No.	24-hr. absorption, pressure head 65 ft.	7-day absorption, pressure negligible	Average absorption	Compressive strength
110	132	91	112	3210
170	104	127	114	2870*
50	119	133	126	3850
230	149	125	137	3660
200	157	149	153	2900*
90	157	164	161	4290
180	196	115	161	3660
120	170	177	174	4080
160	210†	137	174	3900

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*All waterproofing showing a compressive strength under 3000 lbs. considered questionable.

†Waterproofing showing an absorption of 200 cc. or more not recommended. The fairly low average in the case of No. 160 suggests its inclusion in the above table.

Compression tests disclosed a loss of strength in some cases as a result of waterproofing. The decrease was more pronounced in the case of the chemical waterproofing compounds. At least three of that group might be disqualified for work where strength is a consideration. In general, however, the more successful waterproofing methods do not appear to affect seriously the strength of the concrete.

The wide range of results secured from individuals in each group of waterproofers precludes a satisfactory generalization regarding the effectiveness of the several groups as a whole. Apparently no product should be assumed to be a satisfactory waterproofer until definitely proved so by test under conditions approximating those expected in the finished work.

Although the results may be considered fairly indicative of the waterproofing value of the several methods investigated, further work must be done before they may be said to be conclusive. The possible decrease in effectiveness of waterproofing compounds over a period of time—the reason why some methods react differently under different pressures—the true status of the colloids in integral waterproofing—these are among the questions yet to be determined, and which we hope to make the subject of further investigation.

The tests were conducted under the personal direction of the writer by E. L. Brown, and M. T. Baus in the Concrete Testing Laboratory of Case School of Applied Science, Cleveland, Ohio.

New Site for Annual Own-Your-Own Home Exposition

The annual "own-your-home" exposition, held for eight consecutive years in the Coliseum at Chicago under the auspices of the Chicago Real Estate Board, has outgrown the auditorium and the 1929 exposition will occupy an entire city block, at Chicago and now vacant.

Patterned after the great indoor and outdoor expositions held for many years in Europe, the ninth annual "Own-Your-Home" show will be a miniature world's fair on one subject. The entire area will be laid out in accordance with the most modern methods borrowed from European fairs. Pierre Blouke, A. I. A., with the aid of Philip B. Maher, A. I. A., and Ralph E. Stoetzel, A. I. A., conceived the new exposition plan.

To be known as the "Home Port," the exposition will open through immense arched gateways on Chicago Avenue and Pearson Street, on to a garden terrace 200 feet wide.

P. G. RILEY
President

P. G. RILEY
GENERAL CONTRACTOR

T. G. McGOVERN
General Supt.

~~701 Temple Street Pittstown, N. J~~
Los Angeles

Dear Ann:

It is true as you say, I did sort of give you the job of watching the treasury and naturally you are worried over Mac's gambling as you call it, with the company's money, by bidding for every job that comes up. No, I understand the spirit in which your letter was written and I know you too well to think you were tattling.

I wouldn't wonder that the thing which started this bidding thing was the T & B job which he took over after they had gone broke on it and not only finished it for the amount of their bid but made a fine profit besides.

You know, Ann, the P. G. Riley concern has made its way along by taking mostly cost plus jobs from people who knew us and knew that our organization did good work, also that we saved them all the money that could possibly be saved.

The only good thing I can see about this old idea of bidding for construction jobs is that it sure is a great sharpener of wits but I have always thought people with building to do should turn over their plans to an organization equipped with experience, brains, capital and equipment to do this work good as well as economically.

Mac must have experience and I won't interfere and of course you won't voice my disapproval.

When I was a kid I worked in a general store in a small Iowa town where the farmers traded their butter and eggs for provisions. Some of the butter was terrible and was dumped in a sugar barrel at the back of the store to be shipped to some place where maybe they refined it in some way for fine table butter, or maybe they made it into axle grease. But one summer's day the odor wasn't so good so I conceived the idea of wheeling this barrel of butter down the basement. Well, the barrel got the best of me and barrel, smelly butter and boy blended together at the bottom of the stairs. Mac's bidding may get the best of him but after he gets the butter out of his hair and eyes, so to speak, the experience will not have hurt him. Anyway, I expect the worry of making one job carry another will put him on the right track soon.

Possibly you have wondered why I gave the general superintendency job to my youngest superintendent. Well, Ann, for several reasons, I think you should know why.

I knew Mac's father, Charlie McGovern, when he was laying brick for his father. When Charlie got to be thirty years old he figured out that he needed some book learning and went to it, put himself through preparatory school, then through college. Then he started contracting, got married, had two children and made a lot of money. He invested it in Iowa land, found himself with a lot of frozen assets and went broke when he was sixty.

Charlie visited every one he owed and told them they would get every cent back, packed up his grip and went down to Dallas, Texas, put up at the best club there, joined the local bricklayers' union and went to laying brick daytimes and figuring jobs nights. Finally he landed one, then wondered how he was going to finance it. A banker who had met him one evening at the club and the next day much to his surprise saw him laying brick on his own bank building, figured out he had guts enough to make good and so backed him. I met Charlie two years after this and he was prosperous again. I said, "Charlie, are you making a gentleman of leisure out of your boy, Mac?" "Not by a damn sight," says he. "Right now, he is seeing if he can lay as many brick as I used to and by the time he is through school he will probably beat my record."

Charlie's dying request was that I take Mac with me. That's the stuff that is in Mac, Anna, so while he will stub his toe once in a while he, like his dad before him, is capable of bringing the old ship through, for history will repeat itself and blood usually tells.

Mac is red headed and Irish, so look out for your heart, Anna Ryan.

Sincerely yours,

PG

This is the seventh letter of a group whose publication began in the May issue of CONCRETE *written by P. G. Riley, retired contractor, to his superintendent, Tom McGovern, back home. "P. G." is taking his ease in California and the distant fields, where he was once so active himself, look mighty green now.*

Perhaps his greatest pleasure is in keeping in touch with his superintendent and, off and on, his secretary, Anna Ryan. His being away from the scene of activity has given P. G. some new viewpoints and he manages, in his letters, to convey to the young folks some of the ideas in the back of his head. One of the bits of advice he has already given "Mac" concerned the wisdom of investigating operating performance when buying equipment. At another time he hold Mac of the "catch" in the seemingly attractive trade-in offer. There's a lesson, too, he said recently, in not letting old, inefficient equipment eat up the profits.

That there's a fallacy to purchasing the lowest priced equipment offered, "P. G." discovered to his own enlightenment when spurred into looking into the subject by a little incident, he told "Mac" in a later letter.

U. S. Circuit Court of Appeals Holds Straub Patents Valid

Patent Situation in Respect to Cinder Concrete Building Units Remains Unchanged

IN a decision, handed down by the United States Circuit Court of Appeals for the Third Circuit at Philadelphia, on September 26th, 1928, it was definitely held that Straub Patent No. 1,212,840 is valid. This decision is of importance to concrete products manufacturers, coming, as it does, as the latest opinion regarding the much-discussed Straub cinder block patent.

The case involved the validity and infringement of Straub letters patent of the United States No. 1,212,840 for Building Block and Method of Making the Same, which patent was issued to Francis J. Straub and is now owned by Crozier-Straub, Inc., a subsidiary of the National Building Units Corporation of Philadelphia.

In the case before the Court of Appeals, Crozier-Straub, Inc., was plaintiff and the following three concrete products manufacturers were the defendants:

Thomas Graham and Atlantic City Building Block Corporation of Atlantic City, N. J.

Jacob Melmod and Sea Shore Brick and Building Block Co., of Atlantic City, N. J., and

Robert G. Downer of Westville, N. J.

In its decision, the Circuit Court of Appeals also holds that all of the defendants have infringed and remits the cases to the lower court to enter decrees for permanent injunctions against further infringement and to assess damages and profits from the defendants on account of past infringements.

It will be recalled that when CONCRETE reported the decision by Judge Bodine in the New Jersey Federal District Court at Trenton, covering the same case, it was stated this decision did not invalidate the patent in question. It was further stated that “the real question of the validity or invalidity of this patent No. 1,212,840 cannot be decided, in respect to these particular cases, unless and until these cases are taken to the Circuit Court of Appeals and that court reverses its former ruling.” This former ruling, by the way, was a previous decision, handed down in 1919 by the same court in the case of Straub vs. Campbell, in which the court declared the patent valid. At the time of the Federal District Court decision reports published in other journals sought to convey the impression that the Straub patent had been declared invalid. The present decision is a result of appealing the decision of Judge Bodine.

There are many interesting points brought out in the complete opinion of Circuit Judge Woolley regarding the decision handed down on September 26th. Portions of this opinion are quoted below:

“The building block of the patent is a simple one. It is of familiar shape and is intended generally for uses long known. Invention in the product, if any, resides in its constituents which are, cement and water (both old) and ‘a mixture of coarse and fine coal cinder and ashes, retaining all of the original mass.’ Invention in the process, if any, must be found in the manner of making blocks of this constituency, that is, “in crushing and grinding an original mass of coal cinder and ashes without separation, mixing the entire mass of coarse and fine material with a suitable proportion of cement and water, and molding and drying the same in block form.’

“We recognized in the Campbell case that the use of cinders in groutings, foundations, walks, roads and other structures was old and we learned from the few patents in the record that ashes and cinders, screened or washed or otherwise prepared and selected and proportioned with other ingredients had appeared in the patent art, but (again from the record) we found that no one before Straub had, when making building blocks, conceived the idea of taking the *whole* ash product—cinders and ash alike, half burned and wholly burned, lumps and dust—in fact, *the entire run of the grate*, using the whole waste product in its raw state and rolling or grinding the whole mass. This process appealed to us as new and we also thought the product of the process, namely, the cinder block, was new, not in its form but in its make-up and characteristics. While in form it is that of the ordinary building block it has marked features, some improvements on old blocks, others wholly new. * * *

“We have been anxious fairly to show the difference between the record in the Campbell case and that in the cases at bar. The latter reveals the astonishing amount of attention which for fifty years inventors in the cement art have given the subject of cinder aggregates. It does not show, however, that their inventions made any distinctive impress upon the building art. On the contrary it proves that it was not until Straub's invention that the trade turned to blocks with cinder aggregates. Hence we must read the Straub invention in the light of the many prior patents and publications. A study of these has convinced us that our decision in the Campbell case, whether by accident or otherwise, was right. It shows that prior inventors and writers had for half a century, indeed from the very beginning of the portland cement industry, regarded cinders as an aggregate in cement mixtures and had dealt with them in a great number of combinations and proportions and that they had hit upon nearly everything except that which Straub hit upon and had practically surrounded him, yet, we think, without touching him. In some instances they came pretty close, indeed very close, but missed. This very activity in a rapidly expanding art indicates to our mind that if all the others failed to see what Straub saw, then Straub saw something new; and the fact that he saw it through a maze of inventions and publications which others failed to penetrate argues for invention. Moreover the fact that, since our decision sustaining the patent, Straub's conception has founded a great industry, while the conceptions of others resulted only in desultory and sporadic activities, indicates the great usefulness of Straub's invention and justifies our previous finding.

“That the Straub block contains patentably new and useful qualities is clearly evidenced by the unusual demand for it which developed immediately on its appearance in the trade. * * *

“After a careful study of a record which, judged from its size and character, must very nearly cover the art, we are constrained again to sustain the validity of the claims of the patent in suit.

“The infringements charged are in no way related. They will therefore be considered separately.

Crozier-Straub, Inc., et al., v. Thomas Graham, et al., No. 3776.

“There are two claimed infringements by Graham: One charged by the bill and occurring before suit when he started in business in 1924; the other when, after suit and in claimed violation of a preliminary restraining order, he made blocks of another composition in 1925. Contempt proceedings that followed were dismissed and Graham has since practiced the process and made the product which is the principal one in question. We shall call them the 1924 block and the 1925 block.

1924 BLOCK

“According to Graham's testimony this block had the following composition:

15 shovels cinders (original mass, machine crushed)
5 shovels sand
1 shovel lime
calcium chloride (small quantity)
5 shovels cement

“Straub went into Graham's plant before suit and saw his men making mixes preparatory to molding. These he testified were composed of:

24 shovels cinders (original mass, machine crushed)
3 quarts sand
2 quarts lime
1 bucket cement

"Of course, if we believe Straub, the addition of three quarts of sand to twenty-four shovels of cinders was a weak effort to escape infringement. If we take Graham's proportions, the presence of sand and the quantity used might or might not be a device by which to avoid infringement. The testimony of neither witness was contradicted. The use of calcium chloride was merely to facilitate drying. In any event the addition of lime and calcium chloride would not change the characteristics or alter the functions of the Straub block and therefore would not avoid infringement. We cannot measure infringement by comparing shovelsful of sand with shovelsful of cinders; we can determine infringement only by finding whether the quantity of sand used destroyed the characteristics of the cinder block of the patent where cinders and ash alone are used as an aggregate. Even accepting the mix in the proportions testified to by Graham, we find that the resultant block retained the characteristics of the cinder block of the patent in suit and constituted infringement.

1925 BLOCK

"According to Graham the 1925 block was made as follows:

12 shovels cinders, (original mass, machine crushed)
6 shovels slag grit (ground slag)
2 shovels sand
1 shovel lime
5 shovels cement
calcium chloride (small quantity)

Later Graham omitted the one shovel of lime and substituted therefor two shovels of sand, making the aggregate twelve shovels of cinders and ten shovels of slag grit and sand. Here again it is impossible to measure infringement merely by comparing the proportion of sand and grit with the proportion of cinders. The stone aggregate of ten shovels may or may not destroy the characteristics which alone the twelve shovels of original mass, machine-crushed cinders would give the block of the patent in suit. Therefore we shall decide this question not by shovelfuls but by results, which in the block of 1925 show unquestioned changes in characteristics from those of the block of the patent. This Graham block is heavier than the Straub block because of the greater proportion of grit in the form of slag and sand. It is for the same reason stronger in its resistance to compression strains; it is more solid, that is, less porous, because of fewer cells; for the same reason it is less soundproof; nails cannot be driven into it. The plaintiffs, on whom rests the burden of establishing the tort of infringement, though proving a cinder content, have failed to prove that the Graham block of 1925 has the characteristics of the Straub block. Therefore we hold that the Graham block of that period does not infringe. It should be noted very clearly that this decision is rested on that block just as it was exhibited to us and on the testimony as to its composition, characteristics and functions. In the course of the argument the court, conscious that their minds were leaning to a finding of non-infringement by the 1925 block because of differences in characteristics between it and Straub's, but remembering that Graham once thought he had escaped infringement by using a little sand with Straub's cinder aggregate, and being concerned that their judgment, if for Graham, should be restricted to blocks precisely like the one in evidence and should not be used as a screen behind which to change proportions by increasing cinders and decreasing grit and thereby making avail of cinder characteristics of the block of the invention, asked counsel for Graham whether, if the patent should be found valid but not infringed by his block of 1925, Graham would be content as a condition to such a decree in his favor to be enjoined not thereafter to change the proportions of cinders and grit from those in the block in evidence. To this question, curiously enough, Graham, speaking through his counsel, replied that he would not be content with such a decree. Although this attitude of Graham is disturbing, it cannot turn us from a proper decision on the evidence presently before us. This decision we make by holding that the Graham block of 1925 did not infringe. It may be pertinent to say, however, that the court will not regard complacently any diminution that Graham may hereafter make in the proportion of grit and sand content to the cinder content in the manufacture of blocks where such change should be found to infringe.

Crozier-Straub, Inc., et al., v. Jacob Melmod, et al., No. 3777.

"According to Straub's testimony he saw mixes made at Melmod's plant which consisted of a pile of mechanically crushed cinders and one bag of cement with the customary water. Melmod testified that his mixes consisted of lime, calcium chloride, cinders, water and cement, but that at first he added 'a little bit of sand.' Being more specific, he stated the proportions as follows:

18 scoops cinders (original mass, machine crushed)
1 scoop lime
5 scoops (one bag) cement
1 bucket calcium chloride

Manifestly the addition of lime and of calcium chloride to facilitate drying did not destroy the characteristics or hinder the functions of the block of the composition of the patent in suit. Melmod infringed.

Crozier-Straub, Inc., et al., v. Robert G. Downer, No. 3778.

"Downer blocks have been made under several formulas, one:

18 shovels cinders (original mass, shovel crushed)
6 shovels sand
5 shovels (one bag) cement

Later he increased the sand content to eight or ten shovels if the cinders ran very coarse. Moreover he did not machine-grind his cinders; he broke them by a shovel, the pieces that were too large being cast aside.

"Another formula was:

25 parts cinders (original mass, shovel crushed)
10 parts sand
5 parts cement

"Still another:

18 parts cinders (original mass, shovel crushed)
5 parts sand or gravel
5 parts cement

The resultant blocks were, according to the defendants in error, 'on the border line of nailability.' We think they were over the line; they were clearly nailable. Also they were heavier than the Straub block and somewhat stronger because, containing sand, they were denser. The Downer blocks were trial approaches to the danger line of infringement. While the proportions of sand in the several formulas were large and indeed substantial enough to make one believe at first that the resultant blocks were not Straub blocks, yet we find they retained, not in perfection yet in fact, the characteristics and functions of the block of the patent in suit. Therefore we find they infringed."

Concretors Have Opportunity to Hear About Business Paper Aims

The Associated Business Papers, Inc., of which CONCRETE is a member, will hold its annual fall conference on Thursday and Friday, November 15th and 16th, at the Hotel Roosevelt, New York City. The organization will go "on the air" on the occasion of its banquet Friday evening from 9:30 to 10:00 P. M. Eastern Standard time, when speeches and entertainment will be broadcast.

The principal address of the evening, by Wm. Butterworth, president of the Chamber of Commerce of the United States, will be "Business Co-operation as a Public Asset." The introductory address on "The Place of the Business Paper in American Life," will be delivered by C. J. Stark, president of the Associated Business Papers, Inc.

WEAF and the Red Network of twenty stations will be used, through the courtesy of the National Broadcasting Company. Concretors should avail themselves of this opportunity to learn something about the efforts of publishers of A. B. P. papers to serve their readers most completely.

Wisconsin Convention Scheduled for Early January

Moved ahead a full month because of the earlier meeting this year of the American Concrete Institute, the Wisconsin Concrete Products Association will hold its annual convention at the Hotel Plankinton, Milwaukee, on January 10th and 11th.

Wisconsin has always had a convention that has drawn crowds well over the two hundred mark and the program arranged for the coming meeting is believed to be more worth while than any that have gone before.

Every concrete products manufacturer in the middle west is invited to this meeting.

~~ EDITORIAL ~~

Cold Weather Precautions

THERE are many common-sense reasons why the building industry should go ahead with its important work regardless of the fact that cold weather has come. Some of these reasons are presented on other pages of this issue.

There are also many equally important reasons why concretors who place concrete when the thermometer is down near freezing or lower must take the simple precautions necessary to secure a good job under such conditions.

It is only occasionally that we hear of a major concrete failure caused by the freezing of the concrete. Yet there are many instances where the work falls short of perfection—such as surface spalling, weakening of some portion of the concrete or other defects that do not seriously affect the structure. These imperfections do not attain the proportions of a failure and as a result they are often known only to the contractor and the inspector. Yet they are defects and they may lead to more serious results.

Freezing is a real danger in concrete construction. It is true that it is not difficult to prevent freezing when the precautions necessary are taken, but the beneficial effects of winter work are lost if the quality of the concrete suffers. The concretor assumes an extra responsibility when he undertakes winter work. If he recognizes this fact and plans his work accordingly, he benefits.

An Enlarged Field

IT is not often that a new field opens up for an industry. Opportunities for extending existing fields materially present themselves equally seldom. Yet, when such opportunities are presented, very few take advantage of them. The industry seems to prefer to run along in its accustomed groove.

As was pointed out in the report of the meeting of the Concrete Reinforcing Steel Institute, published on another page, there is a large field for extending the uses of reinforced concrete in the many residential buildings—not only individual houses, but apartment buildings—that are now being constructed of less durable and less firesafe materials. Especially in the building of the various types of reinforced concrete floors and thin slab concrete floors over steel joists an opportunity may be found to enlarge the field of the concretor.

Manufacturers of equipment used in such construction have given much thought to this subject and are actively promoting the use of these types of floors. They are always ready to co-operate with any concretor who is seeking to extend his field.

In some cities it is not yet required by law that all apartment buildings be of fireproof construction. It is in such cities especially that a new opportunity awaits the concretor. In view of the tremendous improvements in living conditions in recent years and the increasing emphasis that is being placed on fire safety, it is not unreasonable to advocate a building code that makes the use of firesafe materials compulsory in buildings of this type.

"Influence of Central Mixing Plants"

THE third paragraph of an October editorial under the above caption was interpreted by a number of our readers as endorsing a building code clause that would force concrete for small foundations to be made at a central mixing plant. They were correct in their interpretation of the editorial as it was printed, and they are not to blame for not knowing that the spirit of the editorial as originally written and before the pruning shears of the inspired make-up man were brought into play, was entirely different.

If the editorial had been printed as originally written, it would have gone on to explain that the normal development of the central mixing plant would best be brought about if it were allowed to stand on its own feet; that central mixing plants would be an influence for good in the concrete industry only if they were kept free from politics as well as from indifferent or incompetent management.

This explanation is made in justice to the industry as a whole and to the central mixing plant itself, for we would not wish to be understood as favoring any artificial help or hindrance to a growing institution whose future must be determined by economic law.

The Florida Storm

FOLLOWING in the wake of almost every great disaster are articles, folders and pamphlets purporting to set forth some important lesson that the hurricane, the cyclone or the earthquake has taught the building industry. Too often many of these are merely convenient pegs upon which to hang propaganda boosting one or another type of construction. Such releases usually miss the main point—what has the disaster taught regarding construction practices in general, irrespective of the material used?

As usual, there was a lot of printers' ink used after the recent Florida storm to extol the advantages of this or that construction material. And yet, competent, unprejudiced investigators have found that the real lesson in this disaster, as was the case also in the storm of 1926, was the need for adequate building codes and their observance. It was the shoddily built structure, regardless of its type, that suffered damage and caused injury to its occupants.

Time and again this lesson has been brought home forcibly, and yet each new disaster emphasizes the need again.

"Products Association Accomplishments"

Some Further Comments by Products Manufacturers on an Editorial Published Under the Above Title in the September Issue

In the October issue, some suggestions for reorganizing the National Concrete Products Association were published. These suggestions were made by "Spec" Collins and by Austin Crabbs. It is interesting to note that, though these suggestions came from products manufacturers living in different states, they were almost identical.

Other comments have been received since the October issue went to press. Two of these—one from "Casey" Swanson, the present secretary-treasurer of the association and one from R. L. Gavin, secretary of the Iowa products association—are published on this page.

Further discussion is invited.

Comment from

R. L. GAVIN

I have read with considerable interest your editorial and the articles on the National Products Association in your October issue. I believe that there is an excellent opportunity to start something worth while for the Products Association along the lines suggested by Mr. Collins and Mr. Crabbs.

This year the National Concrete Products Association has refused to function at all and the Iowa organization has about decided to refuse any further support in the way of payment of per capita dues, etc., to the National Association.

There is no question but that if a good strong national organization could be built up that approximately 50 manufacturers of concrete products in this state could be induced to join. I, personally, will be glad to give any assistance I can to bring about reorganization of the National Concrete Products Association along the lines suggested.

Discussion by

A. G. ("CASEY") SWANSON

One of the reasons for lack of accomplishment in the Concrete Products Association is lack of funds. This lack is due largely to the indifference of the association members in general. I do not know why people should be so slow to support their own particular cause as we fellows in the concrete products industry. We are more willing to spend money on airplane rides, football games and everything else than on our own industry. But perhaps it will be better some day.

Of course, we might ask, "What is the Concrete Products Association doing for the concrete products manufacturers?" We must admit that we have fallen down in this particular work, which is the prime effort of every trade association to increase the interest of its own members and help production. In a great many cities there is greater production than in the past. We, here in Omaha, are selling concrete products in jobs that would never have used these materials three or more years previous to now. We have a number of products plants in the city that are turning out good products and have gone out and missionaried the cause in such a manner as to put the idea across to the owner, architect and the builder.

As an association, it seems that we have three problems in common; those of manufacturing, marketing and advertising.

Manufacturing

While the American Concrete Institute in its various committees has taken up most of the problems concerned in manufacturing, there are still many "kinks" which can be taken up in association meetings that will show the "kinks" that the other fellow is using in saving labor and machinery which can be used in our town as well as a town many miles distant. Those things are all beneficial to the industry and I feel that those who are interested in the association are willing to give that information for the benefit of their fellow men.

Marketing

There are many methods of marketing and competitive selling. Every time we hear of clay tile being considered on a job, or even before the job is in the hands of the architect, we aim to sell the idea of using cinder or concrete block for back-up material. If the job is of any size, the volume is great enough to help manufacture and therefore reduce overhead. Some time ago one of our competitors sold a certain brick contractor who was originally a brick mason and who had learned to lay nothing but brick for 40 years. He thought brick was the only masonry material and when asked to use concrete blocks, would infer that he had been born in a brick yard so he was all for brick and clay products. Our competitor, in this case with the efforts of a friendly superintendent, got this man to consider the use of blocks in a certain building where about 15,000 were used. Since then he has had three or four good jobs and he has used concrete products in all of them. We, ourselves, have converted many owners from the use of competitive materials only to lose the job on a price basis. This is discouraging except for the thought that concrete products have been sold.

Advertising

This is where we can do the most good for the industry as a whole. Of course, national advertising takes a great deal of money but national advertising is what pays the

(Continued on Page 38)

Concrete Span for San Francisco Bay Built Largely of Precast Units

Twelve Mile Bridge to Link Bay Cities—Piles, Decking, Curbs and Hand Rails Are Precast in Alameda and Floated into Place—Construction Methods—Handling the Heavy, Precast Deck Slabs — Concrete Control Methods—Casting Yard Layout

By TOM WHITE

THE finest harbor on the Pacific Coast, and one of the finest in the world—San Francisco Bay—has, by reason of its immense area, always presented a real problem of transportation. Of late years, the word "transportation" has given place largely to the word "traffic" which carries with it the idea of a constant stream of vehicles. Vehicular traffic, then, both pleasure cars and trucks, passing back and forth between San Francisco and the East Bay cities and tributary country are obliged to use ferryboats. This means loss of valuable time and acute congestion.

It is to relieve this congestion that a low-level bridge is being pushed across the bay from Mt. Eden, which lies south of Oakland, to San Mateo, just below San Francisco. From shore to shore the bridge will be seven miles long, and with a two-mile approach on the east and a three-mile approach on the west, the structure will total twelve miles in length—the longest highway bridge in the world.

Detailed plans were prepared for the bridge owners, the San Francisco Bay Toll-Bridge Company, by the Raymond Concrete Pile Company, general contractors. Following the approval of the plans by Waddell & Hardesty, bridge engineers, construction was started in December, 1927. While the contract calls for completion within 18 months, or by June of 1929, the present status of the work and the prospect for continued satisfactory progress would indicate that the structure will be completed five or six months ahead of the date specified. Total cost will be approximately $7,500,000.

The decking is 27 feet from curb to curb, with a 4½-ft. hand-rail on each side. There will be four 300-ft. fixed steel spans across the main ship channel, with a central lift span of equal length to allow the passage of shipping up and down the bay.

The following quantities are involved in the project:

1,000,000	cu. yds. dredging.
250,000	cu. yds. grading.
23,000	lin. ft. approach paving.
4,800	concrete piles.
35,700	lin. ft. concrete viaduct.
7,500	cu. yds. pier concrete.
200,000	bbls. cement.
52,000	cu. yds. sand.
106,000	cu. yds. gravel.
9,500	tons reinforcing steel.
2,800	tons structural steel.

Precast Units Floated into Place

Floating equipment is used exclusively, as the bulk of the material going into place is precast in the plant at Alameda, 20 miles away. This was made necessary largely because of difficulties attending the delivery of materials at the bridge-site. Hand-rail posts, caps and diaphragm walls are cast on the job; piles, decking, curbing and hand-railing are precast and floated on barges to the bridge.

Four-pile bents are being capped on the site, the piles being driven by a four-lead driver, the principle of which was developed by the Raymond Concrete Pile Company. The majority of the spans are 30 ft. long and supported by 16-in. square piling. Over deep water, however, which requires longer piling, the spans measure 35 ft. and are supported by 24-in. square piling.

Pile-caps are cast in place by building forms on top of the stay-lathing, which device holds the piles in line until the concrete is sufficiently strong to hold the bent as a unit. Precast deck slabs are then set in place.

These slabs come from the casting plant on barges which are tied up at the bridge and alongside the floating steam crane. Lifting them from the barge in the manner shown in the illustration, the crane lowers each half section, weighing 46 tons, placing it on four 12-in. by 12-in. wooden blocks, located two at each end on the supporting caps. These blocks are placed in such position that the pick-up beam of the slab is properly supported at points previously determined upon.

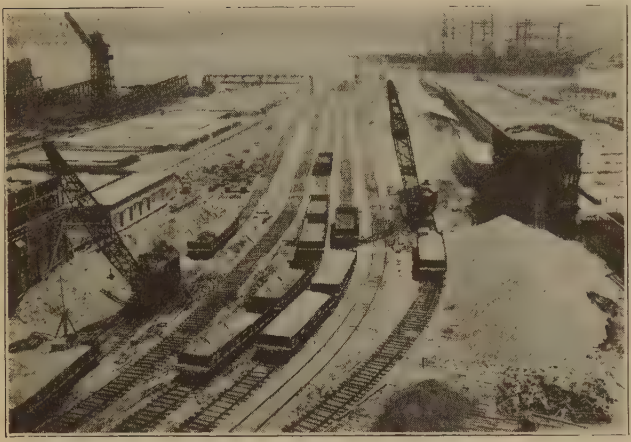
When the slab comes to rest on the wooden blocks, four hydraulic jacks—two at each end of the slab—are placed on the cap, one between each block and the adjacent beam. Attached to each jack is an individual pressure pump and gauge. Two men operate the pumps, one man at each end, both pumping simultaneously and bringing equal pressure on all four gauges. The wooden blocks are withdrawn as soon as the weight of the slab is transferred to the jacks. These jacks have ball-bearing bases and adjusting screws capable of moving the slab in any desired direction while working it into place. When placed according to grade and alignment, the pressure-jacks are relieved by screw-jacks which remain in position under the slab for two weeks while the concrete hardens in the 10-in. diaphragm wall—which wall fills the space between the slabs and forms the continuous deck—and between the bottom of the beams and the caps.

Concrete Control Methods

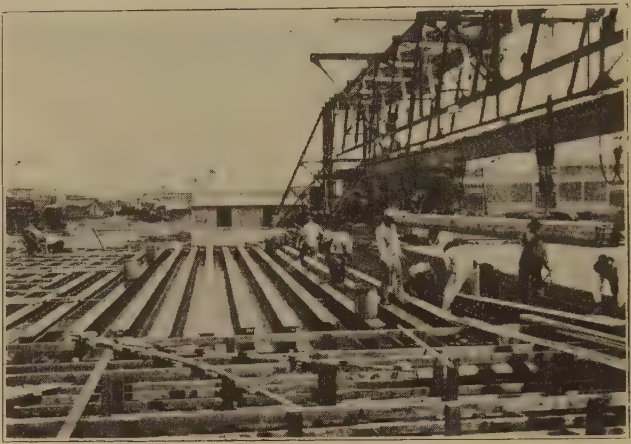
In carrying out specifications for desired strength concrete, the Abrams water-cement ratio method is employed. Recognizing that the most important problem connected with salt water construction jobs is that of impermeable concrete, the Raymond company's engineers have made every effort to obtain sand and gravel of ideal gradation, proportioning them in such manner as to arrive at a

AT THE CASTING YARD

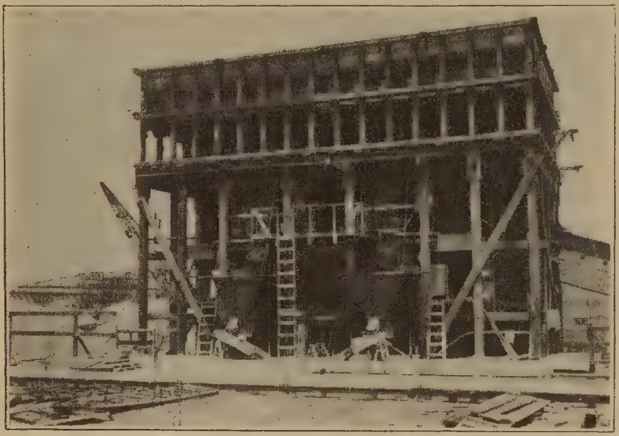
The piles, deck slabs, curbs and hand rails used in building the Mt. Eden-San Mateo bridge across San Francisco Bay were precast at the Raymond Concrete Pile Co. yard at Alameda and floated to the bridge site



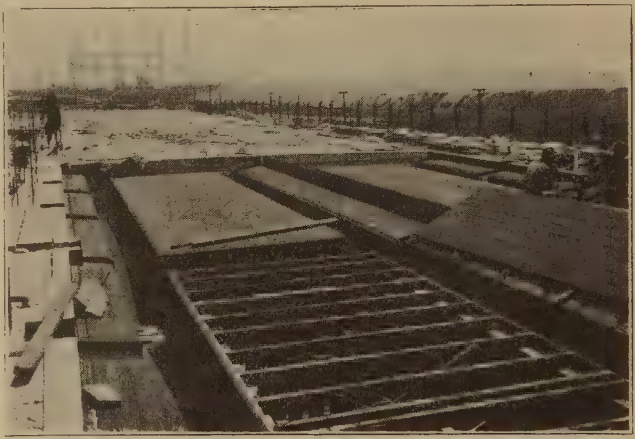
General view of the casting yard at Alameda, 20 miles from the bridge site. At the right is the mixing plant and form yard for the deck slabs. At the left is the pile storage yard



In the piling yard. A steam traveling crane picks up the piles with especially rigged blocks that equalize the strain at all points. 72-ft. piles are suspended at 3 points; longer piles at 4 points

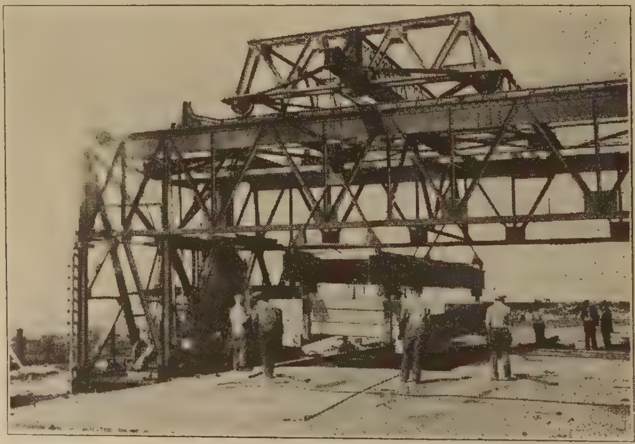


One of the mixing plants at the casting yard. Each plant is equipped with two 1-yd. mixers. Concrete for the piles is taken direct from the mixer in buggies. For the slabs, it is taken in a skip car to three distribution points



Forms for casting the deck slabs. A steel plate runs through the center of a complete 30-ft. span, dividing it longitudinally into halves to facilitate handling. The inside forms drop 3 in. to permit easy removal of the slabs

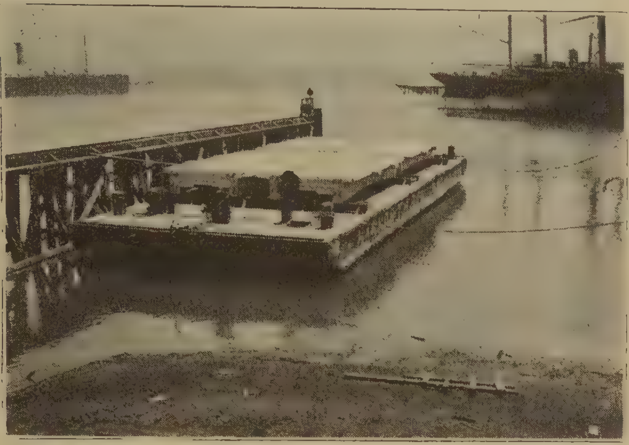
The piling yard has storage space for 1,000 piles, or five weeks' supply. Yard space and docking facilities were leased from the Bethlehem Shipbuilding Co.



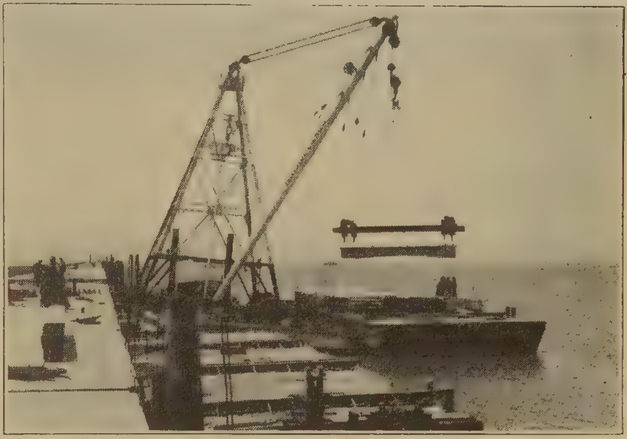
Picking up a cured half-section of decking weighing 46 tons, before placing it on the barge at the lower end of the crane runway. This 100-ton crane was built especially for this job

AT THE BRIDGE LOCATION

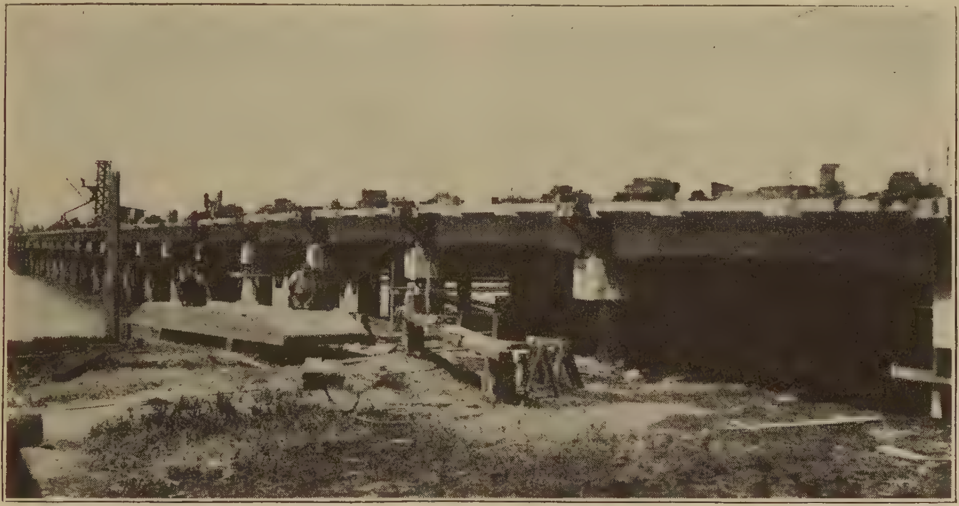
Floating equipment is used exclusively at the bridge site. Hand-rail posts, caps and diaphragm walls are cast in place. Four-pile bents are driven by a four-lead driver



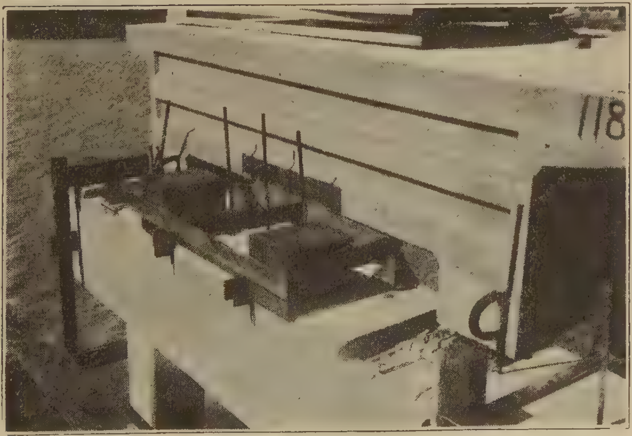
A barge loaded with four half-sections of deck slabs. These will provide 60 ft. or two spans of completed roadway



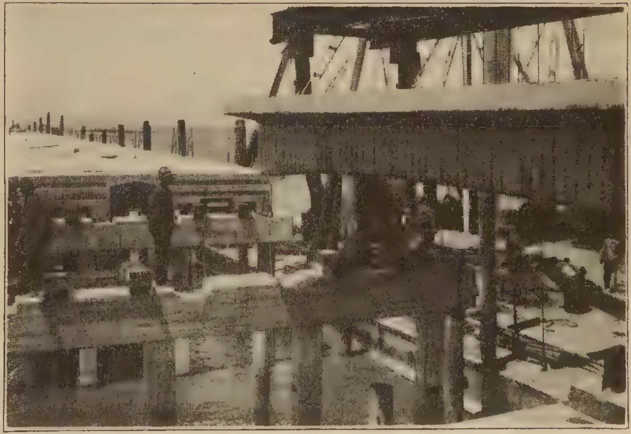
A heavy-duty wrecking crane is moored between the loaded barge and the bridge, lifting and placing the slabs



A section of the bridge, showing the piles, pile caps and decking, in place. From shore to shore, the bridge will be 7 miles long with a two-mile approach on the east and a three-mile approach on the west



Deck slab section in place, resting on jack screws. The wooden blocks are used for taking the weight of the section when first laid



Deck slab, suspended by the floating crane which lifts it from the barge and places it on the pile caps prepared for it maximum density. All tests on the work so far indicate they have been highly successful in carrying out this idea.

The results of daily tests on both deck and pile concrete have shown strengths and densities well above specification requirements. A completely equipped laboratory is maintained in the casting yard at Alameda, and is operated by the contractor under the supervision of a concrete engineer for the Raymond company. Every carload of sand and gravel is sampled and several analyses made of each in order to determine whether any change should be made in the mix being used. In addition to these tests, laboratory assistants make 6- by 12-in. concrete test cylinders each day from concrete of the two grades. Pile concrete is specified at 4,000 lbs. per sq. in., and concrete for decking, caps and diaphragm walls, at 3,000 lbs. per sq. in.

All concrete placed is carefully water-cured for 28 days, this practice being considered most essential in securing durable concrete.

Casting Yard

In the pile-casting section of the yard there are 200 forms laid out to take piles ranging from 45 to 110 ft. long and measuring 16 by 16 in., 18 by 18 in., 20 by 26 in., and 24 by 24 in. Piles remain in these forms 7 days, and are then lifted out and put in storage for 3 weeks longer. To secure more even settlement, the forms are built on stakes, there being 13,000 driven in this portion of the yard. Piling forms are used over and over again, the average being 27 times.

On the other side of the yard is the section devoted to casting the deck-slabs. Details of these forms and method used to support the end beam structure are clearly shown in the accompanying photographs. A steel plate runs through what corresponds to a complete 30-ft. span, dividing it into two 46-ton halves to facilitate handling. The inside beam forms for the slab sections drop 3 in. to allow the easy removal of the slab, the balance of the form remaining stationary. Like the piling forms, these are used over and over again, the average in this case being 12 times.

Transportation of Slabs

Deck slabs are cured in their forms for 12 days, when they are lifted out with the gantry crane, moved to the tide-water end of the slab-casting yard and lowered aboard the waiting barges which are moored directly under the crane runway. The barges now in use accommodate 4 half sections of deck-slabs, or 60 ft. of bridge decking. These barges will soon be replaced by car-floats taking 10 slabs, or 150 ft. of decking.

The slab yard is 1,580 ft. long and consists of two rows of complete decking, or 3,000 ft. of deck sections as they will appear in place. This much is cast every two weeks, and represents 4,400 cu. yds. of concrete cast in this part of the yard every fortnight.

Concrete Distribution

There are two complete mixing plants in the yard, each having two 1-yd. mixers—Ransomes and Koehrings. These plants are of the overhead bin type fed by locomotive cranes bringing sand and gravel direct from the cars to the bins. Each mixer is equipped with measuring hoppers to insure accurate control of the aggregate. Cement is delivered from the storehouse to the plant on belt conveyors, the storehouses being supplied from the incoming cement barges by narrow-gauge train service using Plymouth gasoline locomotives.

Piling concrete is handled and distributed in the ordinary manner by the use of buggies coming directly from the mixing plant which serves the pile casting yard.

Concrete coming from the mixing plant at the slab casting yard is distributed from three points. This is necessary by reason of the extreme length of this yard—well over a quarter of a mile. The mixing plant at the slab yard is situated equidistant from the extreme ends, which serves the work in progress at or near the center of the yard. When pouring is going on at either end, concrete is distributed by means of an inclined railway and a 2-yd. car dumping into overhead bins. From each of these three distribution points concrete is delivered to the forms in buggies.

Size of Yard

All yard space and docking facilities at the Alameda plant, which combine to form an ideal location for this work, has been leased from the Bethlehem Shipbuilding Company, whose operations have been greatly curtailed since the close of the war. As it now stands, with trackage—both narrow and broad gauge—mixing plants, steam and gasoline motive power, rolling stock and other equipment, the entire yard represents an outlay of $300,000, and is large enough to accommodate 60 standard railway cars.

A three-days' supply of cement, sand and gravel is maintained in the yard at all times. Cement comes in on barges; sand and gravel are delivered by rail. Reinforcing steel, of which approximately 10,000 tons are being used, is unloaded from steamers and transferred by barge to the yard docks.

Specially Built Cranes Used

Of particular interest in the matter of yard equipment are the two steam gantry-cranes of the traveling type, both especially designed for this job. One crane serves the slab yard and has an 85-ft. span and 100-ton capacity. The piling crane is equipped with equalizing blocks which handle the load with an equal weight distribution at each point, this being most essential in the moving of concrete piles. Piling up to 72 ft. long is suspended at three points; over 72 ft. long, at four points. Pick-up is accomplished by means of T-bolts embedded in the piling with nut and steel plate 6 in. square and ½-in. thick. The bolt is well greased before going into place to allow of easy removal as soon as the piling goes into storage. The piling yard has sufficient storage space for 1,000 piles, this being equal to a five-weeks' supply.

A 40-ton steam locomotive switches and spots the sand and gravel cars. A McMyler 70-ton steam locomotive crane serves each of the mixing plants.

Building the world's longest highway bridge and floating it into place, section by section, contributes toward making this an outstanding example of engineering skill, particularly as applied to the use of concrete for permanent construction. In addition to this, the San Francisco Bay toll-bridge job presents the spectacle of perfect co-ordination between two widely separated plants—one producing the precast material, the other setting this material in place, each day marking added progress as the big, white bents, capped with ponderous decking, push their way farther and farther out into salt water. No small part of this co-ordination is due to the prompt dispatching of barges, which means a steady stream of loaded carriers bound for the bridge-site, promptly unloaded and just as promptly returned for more material.

Concrete Runway at Ford Airport

Description of the New Concreted Landing Field at Detroit—Design and Construction of Runways—Service Requirements to Be Met

By E. K. SMITH

THE first concrete runway to be constructed in the United States was, this year, placed in service at the Ford airport, Dearborn, Michigan. The construction of this first fully paved runway in the United States is notable as an indication of the permanence and stability of the commerce of the air. Incidentally, it is one demonstration of the increasing importance of the Ford Motor Company in the field of commercial aviation.

In the first three months of use, this runway has shown its worth in materially reducing the distance required for take-off, and its advantage will be still further demonstrated during the winter months.

At the Dearborn airport are located the experimental shops, factory for the Stout Metal airplanes, and the hangars and passenger station of the Stout Air Service, operating regular passenger service to Cleveland and sightseeing trips over Detroit. Planes in the service of the Ford Motor Company leave this airport with urgent express cargoes for Chicago, Buffalo and other Ford distributing points. As one of the best equipped airports in the United States, it is visited by many other planes.

The 12-passenger, all metal airplanes are in operation today on the National Air Transport, Stout Airlines, Robertson, Boeing, and other important air service lines. The Ford airport is developing, not as an experiment, but as a serious business proposition. This is one of the few airports in the United States that compares favorably with European airports in the quality and appearance of its buildings.

As a business proposition, planes in commercial service will become increasingly heavier. The operating expense of carrying a "pay load" of 3,000 lbs. is very little greater than for a "pay load" of 500 lbs. The Stout All-Metal 4-AT planes have a gross weight of 10,000 lbs.

Construction of First Section

The Ford landing field had a good turf surface, well drained, but the difficulty of keeping this surface in good condition during thaws and sudden freezes in winter, soon showed officials of the Ford Motor Company the need for pavement for all-year, all-weather service on schedule time. The first section of the concrete runway, 600 ft. long by 75 ft. wide, was commenced late in 1927, and only partially completed when winter set in. The entire runway was completed in the spring of 1928. The runway as completed is 2,653 ft. long, and 75 ft. wide, connecting with the wide concrete driveway running along the hangars to the passenger station. Additional room for turning around is given by making the runway 125 ft. wide for the last 100 ft. Approaching the passenger station and hangars the runway is widened to 150 ft.

Concrete Specifications

To provide for the 5-ton planes now operating, the pavement was laid of one-course concrete 7 in. thick, the mix approximating 1 part portland cement, 2 parts sand, and 3¼ parts gravel. The specification read as follows: "Concrete shall be proportioned to give the necessary workability without exceeding a water-cement ratio of 5¼ gallons of water to one sack of cement, which is the maximum permissible. Water or moisture contained in the aggregates must be included in computing the amount of water to be added to each batch."

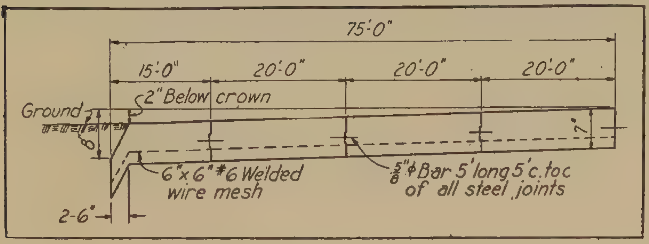
The use of a finishing machine was required, and the concrete was then rolled and belted and tested with a straight-edge to insure a smooth surface with no irregularities greater than ¼-in. in 10 ft. A little extra care was taken to insure a smooth surface across all joints. Wire mesh reinforcement weighing 42 lbs. per 100 sq. ft. was placed 2 in. above the bottom of the slab.

Design of Runways

Premoulded expansion joints ½-in. thick were placed across the runway at 40-ft. intervals. Parallel to the axis of the runway, the pavement is separated into slabs 20 ft. wide by deformed metal joints. Five-eighths in. steel dowels, 5 ft. long, were placed on 5-ft. centers, across the longitudinal joints to hold the slabs in close contact. The outer edge of the slab was dropped 8 in. in the last 30 in. of width and the turf carried over to make a smooth connection. Along a part of the runway, 3-ft. shoulders of slag or cinders, 7 in. thick after rolling, were placed next the slab to give a transition from concrete to turf. About two-thirds of this runway is concrete, but in the center are several hundred feet of heavy bituminous macadam, laid as a part of the experiment.

The Otis Construction Company of Detroit hold, with the Ford company's own plant organization, the honor of having shared in the construction of the first concrete runway at any American airport.

It is sometimes asked if the traffic at a field justifies pavement. This airport serves primarily the Ford Motor Company proper and Stout Air Services. Since the airport was opened in April, 1925, only three years ago, it is estimated that over 10,000 take-offs have been made by the Ford tri-motor ships, with an equal number of landings. Thousands more take-offs and landings have been made by visiting planes, including the participants in the Annual Reliability Tour. Ford planes using this field have carried over 1,250,000 letters and 6,000,000 lbs. of freight. The Stout Air Service carried 19,000 passengers in 1927 and 26,969 during the first seven months of 1928. This increased business is enormous, but is paralleled by the increase in the air mail carried since the rates were lowered August 1 to 5c for the first ounce.


75'-0"
15'-0"
20'-0"
20'-0"
20'-0"
2" Below crown
Ground
8"
7"
6"x6" #6 Welded wire mesh
5/8" ϕ Bar 5' long 5' c. to c of all steel joints
2-6"

Standard cross-section for concrete runway

With a concrete surface the expense and inconvenience of graders to keep the field smooth is greatly lessened. The heaviest plane taxies, in all weather, smoothly and surely down the concrete, to the point of take-off, without bump or jar. The distance required for a perfect take-off is materially lessened, although it is not felt advisable to reduce the length of runway. The additional length gives a factor of safety that will be still more valuable as the size and weight of loaded planes continue to increase.

Concrete Found Advantageous

Officials of Stout Air Service, Inc., call attention to another advantage: "The take-off from the smooth, uniform surface is always positive. The pilot knows that the plane lifts off the surface only after it has attained flying speed. Passing over a bump or rut, on turf or cinders, the plane sometimes bounces into the air with a false take-off before sufficient flying speed has been attained."

The runway has been marked with diagonal painted stripes to show proper take-off distance from either end. If the pilot has not taken off by the time he reaches this point, he slows down and taxies back for a new take-off. The concrete is especially adapted for such control markings.

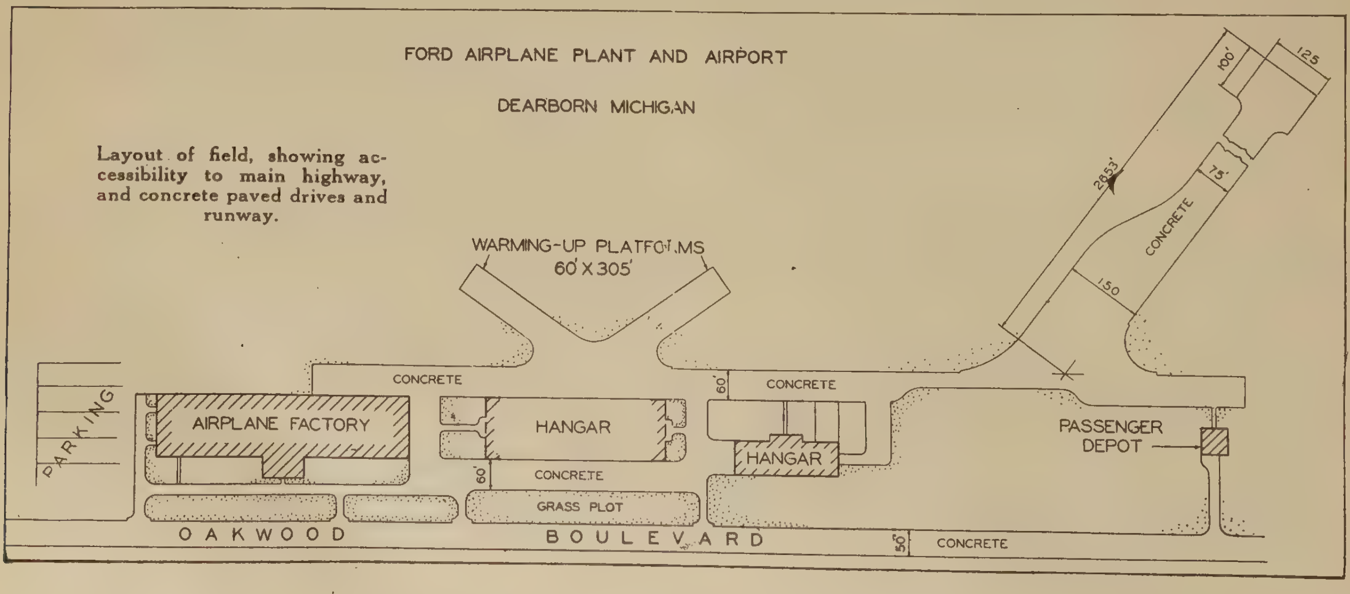
During the summer the principal use of the runway has been for taking off, although a considerable number of landings have been made on it. The Ford officials feel that its value for landing will be best demonstrated during the winter and spring, when, for weeks at a time, the turf may be frozen or soggy with water. According to W. B. Mayo, who directs the Ford Motor Company aviation activities, this concrete runway has proven so satisfactory during the first few months of service, that another is planned for immediate construction, at right angles to the first. The service rendered by this concrete runway shows that smooth, durable, uniform pavement for the use of heavy planes in passenger, mail, and express service that must operate on schedule time every day in the year is as valuable as the service of hangars, shops, passenger stations, and other ground facilities.

Road Builders Program

From present indications, the 1929 convention program of the American Road Builders Association will include many carefully studied committee reports made by leading officials of states, counties, cities and Latin-American countries.

The program this year is again to be divided into days devoted to specific types of road work. Saturday, January 12th, will be Manufacturers' Day, preceding the show and convention. Other days scheduled are City Officials' Day, County Officials' Day, Pan-American Day, and Contractors' Day.

The reports of the standards committees of the various divisions will be supplemented by those made by several special committees recently appointed to study road problems of general importance. Among the committees are those on Depreciation of Equipment and Study of Lien in Public Construction.



Layout of field, showing accessibility to main highway, and concrete paved drives and runway.

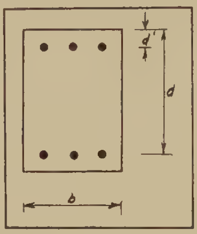
Reinforced Concrete Design Simplified

Chart G—Unit Stress in Compression Steel Beams Reinforced for Compression

By PROF. JAS. R. GRIFFITH
Armour Institute of Technology; Assoc. M., A. S. C. E.

Joint Committee Specifications

$f'_c = 2{,}000$ lbs. per sq. in.
$f_c = 800$ lbs. per sq. in.
$f_s = 18{,}000$ lbs. per sq. in.
$n = 15$
$f'_s = 30{,}000\,(0.4 - \frac{d'}{d})$



If economy of materials and space were entirely disregarded, all beams could be designed on the basis of the preceding discussions. Headroom, alone of many considerations, frequently limits the size of a beam so that balanced tensile reinforcement is inadequate. Under such circumstances additional steel is added to carry the surplus load.

The inexperienced designer usually tries to avoid the design of beams reinforced for both tension and compression because he lacks a thorough understanding of the problem. The many complicated charts, already in existence, add to the confusion of this comparatively simple problem.

The well-known method of analysis wherein the problem is separated into a series of simple steps is not only easier to grasp and retain, but is in a form more adapted to nomographic solution.

Chart A shows quite clearly that any beam of fixed size, with its required amount of balanced reinforcing, will offer a definite resisting moment. If this moment (M_1) for balanced reinforcing is subtracted from the total required moment (M), the remainder (M_2) must be carried by additional reinforcing in both the compression and tension sides of the beam.

$$M - M_1 = M_2$$

The additional steel necessary to develop the surplus moment (M_2) is figured as a force couple, Fig. 1-G.

If the additional steel on the compression side of the beam is located at a distance (d') from the extreme compression fibers, and the additional tensile steel is located in the same horizontal plane with the balanced reinforcing, the arm of the force couple is ($d - d'$). The magnitude of the couple, for equilibrium, is then

$$M_2 = C'(d - d') = T'(d - d') \qquad (1)$$

Since the stress varies directly with the distance from the neutral axis, the following expression can be written:

$$\frac{f'_s}{f_s} = \frac{kd - d'}{d - kd} = \frac{k - d'/d}{1 - k}$$

f'_s = unit stress in compression steel,
f_s = unit stress in tensile steel.

Since the additional tensile steel (A_{s2}) is at the same distance from the neutral axis as the balanced reinforcing, it will carry the same stress ($f_s = 18{,}000$ lbs. per sq. in.). The expression, for the stress in the compression steel, can then be written

$$f'_s = f_s\left(\frac{k - d'/d}{1 - k}\right) = 18{,}000\left(\frac{k - d'/d}{1 - k}\right)$$

If enough steel is added just to carry the surplus moment, the position of the neutral axis remains unchanged. The value of ($k = 0.4$) can then be used. The expression can then be further simplified to

$$f'_s = 18{,}000\left(\frac{0.4 - d'/d}{1 - 0.4}\right) = 18{,}000\left(\frac{0.4 - d'/d}{0.6}\right)$$

$$f'_s = 30{,}000(0.4 - d'/d) \qquad \text{Eq. 1-G}$$

Chart G has been designed to solve Eq. 1-G by the use of one straight line or isopleth. It will be seen from Chart G, when the location of the tensile and compression steel is determined, a straight line from (d) through (d') will give, on the right scale, the unit stress in the compression steel.

Using the notation:

C' = total compression carried by the compression steel,
T' = total tension carried by the additional tensile steel,
A'_s = total area of compression steel,
A_{s2} = total area of additional tensile steel,
f'_s = unit stress in compression steel,
f_s = unit stress in tensile steel,

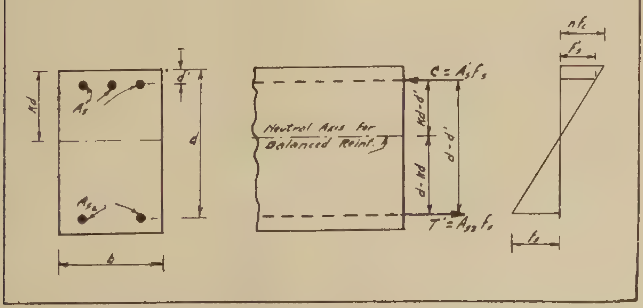


Figure 1-G

the following equations can be written from expression (1):

$$M_2 = A'_s f'_s (d - d') \qquad \text{Eq. 2-G}$$

$$M_2 = A_{s2} f_s (d - d') \qquad \text{Eq. 3-G}$$

The amount of compression steel and additional tensile steel can be determined from the above expressions. The graphical solution of these two equations will be taken up in the next issue.

Since Charts G and H must be worked together, a problem involving their use will be deferred till the next issue. The isopleth shown on Chart G is for this problem.

The first, and frequently most difficult, problem in chart construction is to get the equation into one of the type forms. Eq. 1-G, as it stands, has but three variables but in an impossible arrangement for nomograph construction. So the following transposition will be made:

$$f'_s = 30{,}000(0.4 - d'/d) \qquad \text{Eq. 1-G}$$

$$f'_s = 30{,}000\left(\frac{0.4d - d'}{d}\right)$$

$$f'_s d = 12{,}000\, d - 30{,}000\, d'$$

$$d' = \frac{d\,(12{,}000 - f'_s)}{30{,}000}$$

If the quantity $(12{,}000 - f'_s)$ is taken as one variable, this last expression corresponds to the general nomographic expression (Eq. 7) requiring logarithmic co-ordinates. Thus the central (C) scale will contain values of (d'), the left (L) scale values of (d), and the right (R) scale values of $(12{,}000 - f'_s)$. Equating the general exponents of Eq. 7

$$C = L^{mn/r} \,.\, R^{m(1-n)} \qquad \text{Eq. 7}$$

to the actual exponents of the variables in Eq. 1-G rearranged

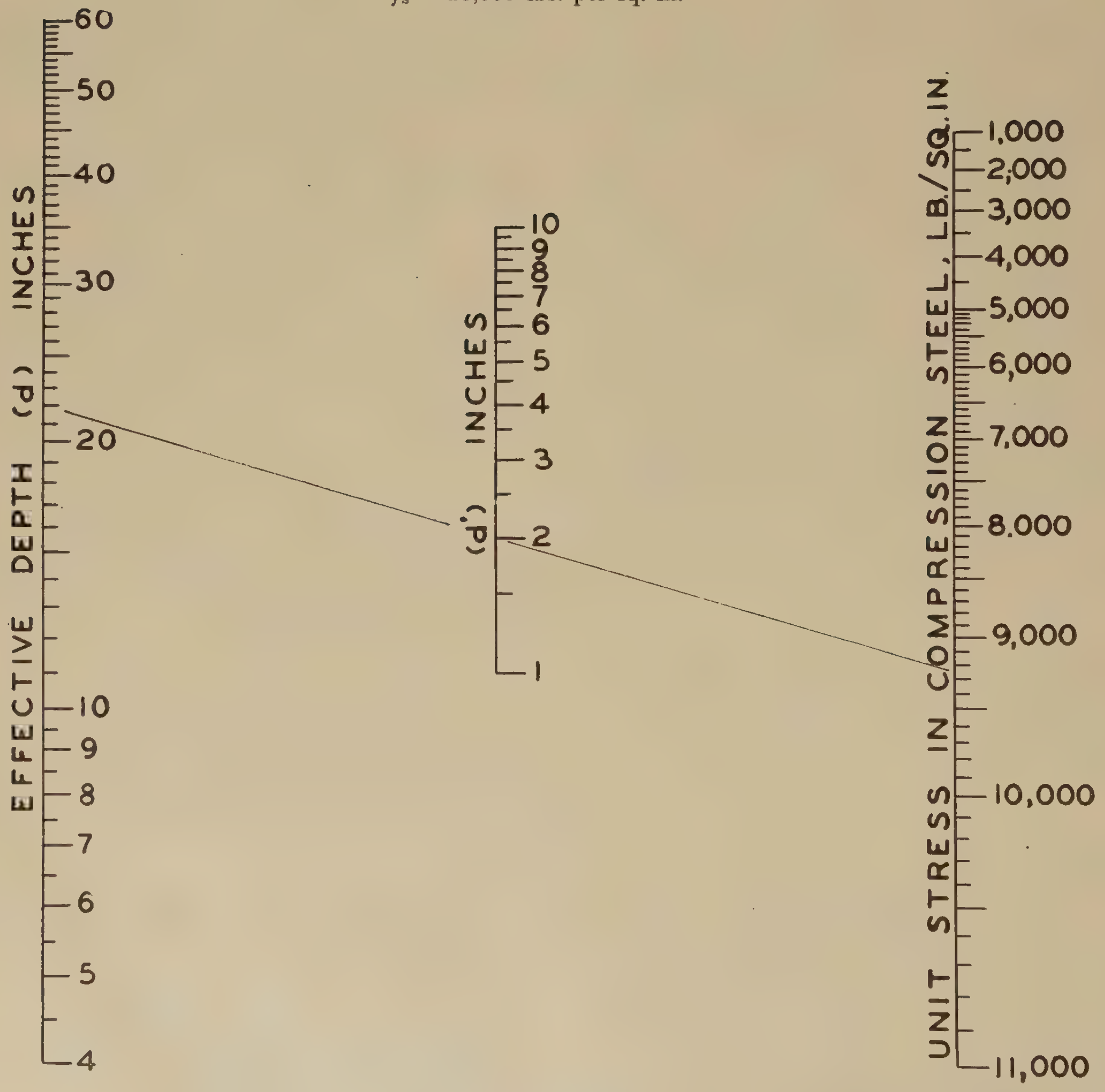
$$\left.\begin{aligned} \frac{mn}{r} &= 1 \\ m(1-n) &= 1 \end{aligned}\right\}$$

The $(A\text{-}10)$ scale was used for the (L) and (R) co-ordinates making the ratio $(r = 1)$. Substituting this

CHART G

Beams Reinforced for Compression
Unit Stress in Compression Steel

$f_s = 18{,}000$ lbs. per sq. in.



value of $(r = 1)$ in the first of the last two expressions and solving them simultaneously, we get:

$$\left.\begin{aligned} mn &= 1 \\ m(1-n) &= 1 \end{aligned}\right\}$$

$$\left.\begin{aligned} \frac{n}{1-n} &= 1 \\ n &= \frac{1}{2} \end{aligned}\right\}$$

$$\left.\begin{aligned} m(\tfrac{1}{2}) &= 1 \\ m &= 2 \end{aligned}\right\}$$

Since $(n = \frac{1}{2})$, the central scale must be half way between (R) and (L). The value $(m = 2)$ indicates that the co-ordinates on the central (C) scale will be one half the size of those used for (R), necessitating the use of the A-5 scale.

If it were possible to place the compression steel at the outer edge of the compression concrete, the maximum stress would be

$$f'_s = n f_c = 15 \times 800 = 12{,}000 \text{ lbs. per. sq. in.}$$

This condition is a physical impossibility, one to two inches of concrete being necessary for protection. So the maximum value of (f'_s) was taken as 11,000 lbs. per sq. in. In calibrating the right (R) scale for values of $(12{,}000 - f'_s)$, the designer's time was further saved by making the subtraction on the chart. The scale was started at the bottom of the sheet at a value of $(12{,}000 - f'_s = 1{,}000)$ which corresponds to a value of $(f'_s = 11{,}000)$, and was so labeled. Likewise the value of $(f'_s = 10{,}000)$ would fall at the point on the log scale.

$$12{,}000 - f'_s = 12{,}000 - 10{,}000 = 2{,}000$$

The rest of the scale was calibrated in a like manner. The left scale was calibrated for values of (d) from 4 to 60 inches. A construction isopleth was drawn, for convenience, through the values $(d = 10)$ and $(f'_s = 1000)$ giving a central scale value at the isopleth of

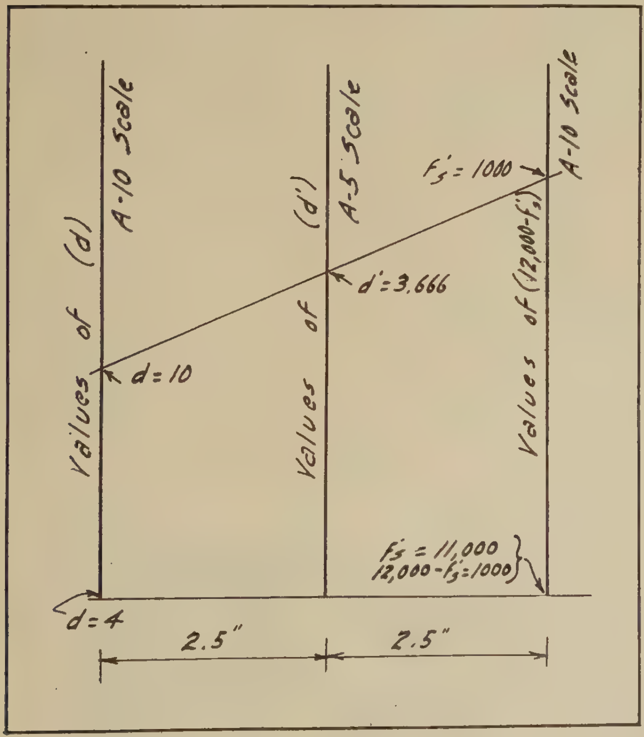


Figure 2-G

$$d' = \frac{d(12{,}000 - f'_s)}{30{,}000} = \frac{10\,(12{,}000 - 1{,}000)}{30{,}000} = 3{,}666$$

This gives a starting point for the calibration of the central scale for values of (d').

The details by which the original of Chart G was constructed, are shown on Fig. 2-G. Those desiring to construct a similar chart for other values of f_c or f_s must substitute the proper values in Eq. 1-G. The spacing and relative size of the co-ordinates will remain unchanged.

P. C. A. Files Answer Before Federal Trade Commission

Washington, D. C.—Dismissal by the Federal Trade Commission of its complaint against the Portland Cement Association, its officers and members, is sought in an answer filed on their behalf September 22nd and made public by the commission on October 5th. Counsel for the association and the cement manufacturers represent that the commission is without jurisdiction on the ground that the charges made against them alleging disparagement on the concrete road construction methods employed by the American Vibrolithic Corporation and its licensees, present no instance of competition in interstate commerce, whether fair or unfair. The answer asserts that as the respondents are engaged only in the manufacture and sale of cement and as they do not deal with paving contracts and road machinery they do not come into competition in commerce with Vibrolithic organizations.

Disparagement of the Vibrolithic process by any and all of the means alleged in the commission's complaint is denied. With particular reference to the charge that the association prepares and furnishes its agents with printed matter decrediting the merits of the Vibrolithic process, the answer states that "from time to time the association has supplied its agents with data relating to extravagant and in some instances false claims and statement of supposed fact made by the Vibrolithic Corporation and or its subsidiaries and licensees—and this, respondents aver, was right and proper."

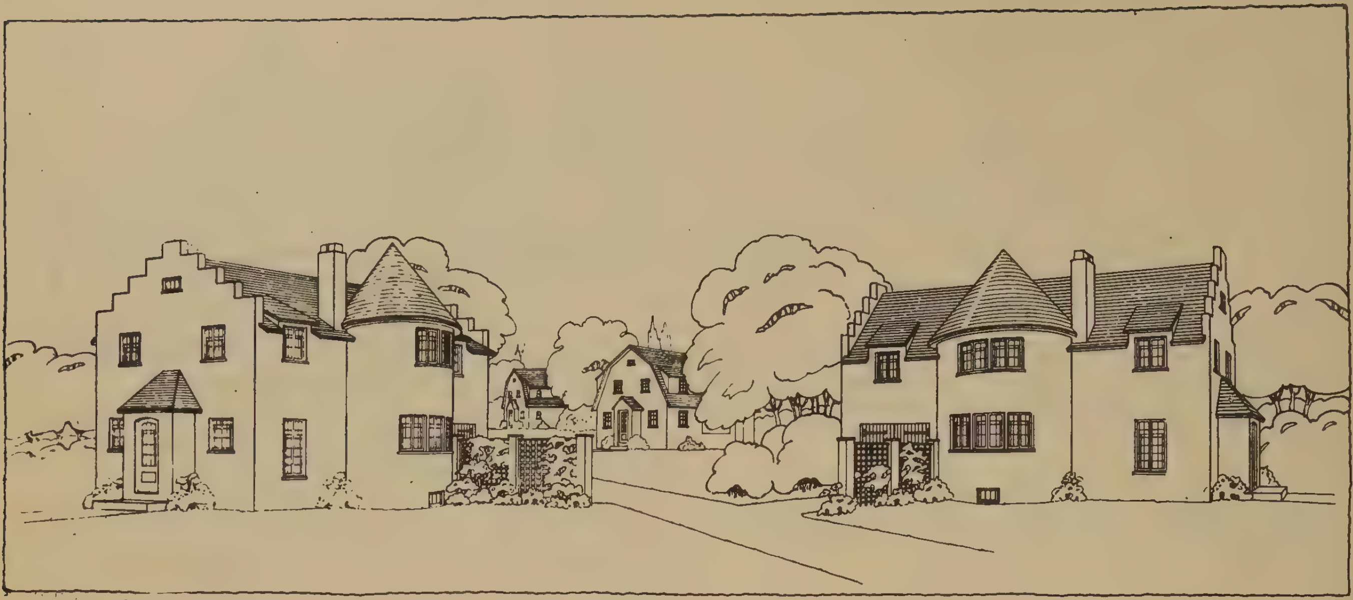
One of the counts of the commission's complaint charged that the association inspired publication in an engineering magazine of an article disparaging and discrediting the Vibrolithic method. The answer asserts that the publication was "true in every particular and in no sense constitutes an unfair method of competition in commerce."

Exception is taken to the claim of the Vibrolithic Corporation, as recited in the commission's complaint, that its process results in a firmer or more durable construction than other methods of concrete road construction.

The answer alleges that the association promotes the construction of concrete roads only in the sense that it advocates concrete roads. Neither the association nor its members enter into paving or road making contracts. The members sell their products without discrimination to any person, firm or corporation. For these reasons, it is claimed that nowhere do they compete with Vibrolithic organizations.

September Costs Up

Construction costs rose slightly during September, reaching the exact position they held one year ago, according to statistics just compiled by the Associated General Contractors of America. The rise was the third in four months and placed the average of costs for the first nine months of this year slightly above that recorded for the corresponding period of 1927.

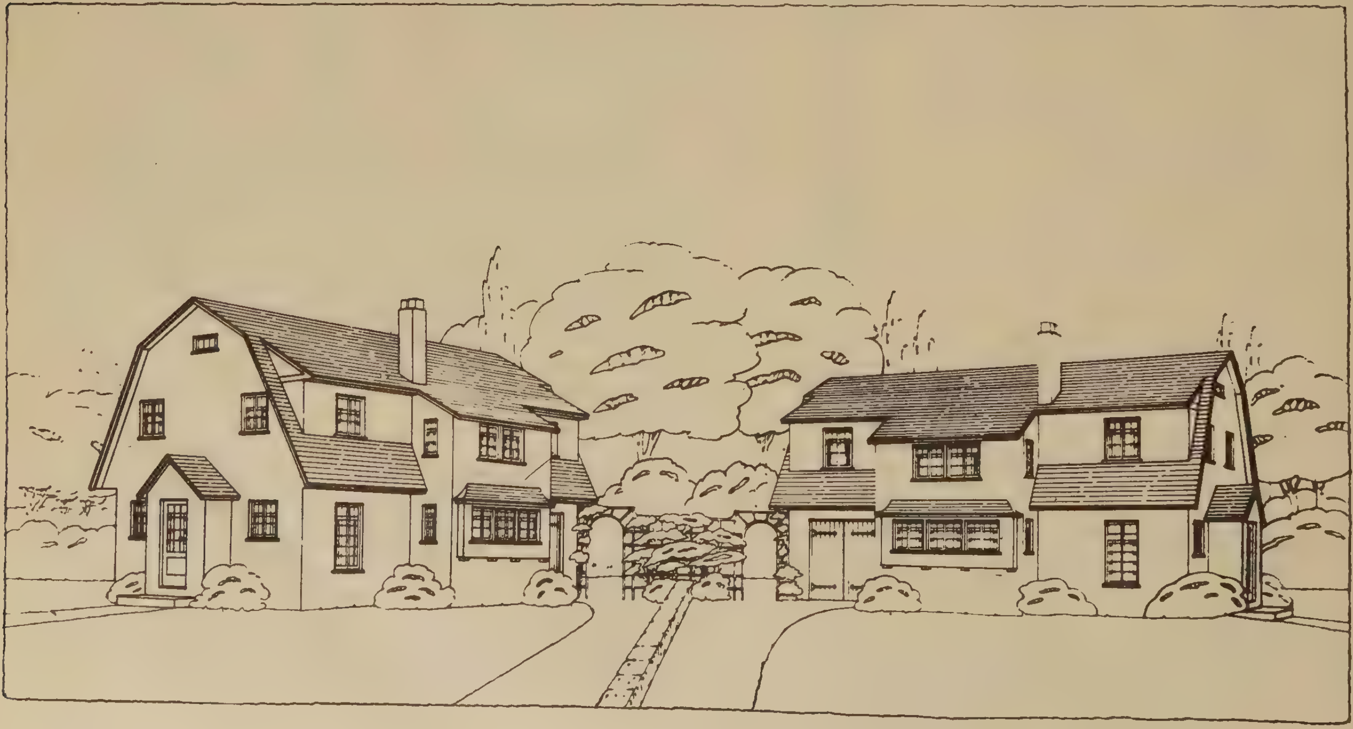


Miss Gleason's Northern Houses

Kate Gleason, Builder, Continues to Use Innovations in Erecting Concrete Houses for the Average Worker at East Rochester, New York—Some of the Plans She Is Using

ON the head of Miss Kate Gleason rests the crown of dean of women builders of the United States. For eight years now Miss Gleason, who resides at East Rochester, New York, part of the time and at Sausalito, California, at other times, has been building comfortable, economical and thoughtfully designed concrete houses for the industrial worker.

Miss Gleason has her own way of doing things, always a little different and many times a little better. Miss Gleason does not pretend and we do not think she has yet built the Perfect House. Miss Gleason is always learning, but once she has learned, she is not afraid to put tradition aside and do the job her way. In this article Miss Gleason tells of some of the work she is doing. The article is of value to the concrete products man as well as to the reinforcing concretor. The former will find the design econo-



mies suggested excellent means of rendering some additional service by passing them on to contractor-purchasers in one way or another.

She considers five men sufficient on a house job. Miss Gleason says, "The leader can work and direct the other four. More than five require so much directing that the leader himself cannot work. Three men could build a house but it would be under way too long. For the electricity and plumbing required, business men who retain their licenses can usually be found to oversee their particular kind of work to secure the necessary certificates from the underwriters and the plumbing boards."

In reply to the question asked her of cutting costs, Miss Gleason said, "It seems to me that the greatest single factor in the success of cutting costs is to employ handy men instead of skilled tradesmen. For the handy man any building work is a promotion, even though it is the building of a small house."

Miss Gleason has made a number of experiments with types of equipment and has come to some definite conclusions. On this subject, she says, "I have found that the machinery which is so essential on big buildings is designed for them and is too expensive to move for small jobs. For my own use I have found a two-wheel mixer with a 2½ h.p. engine about right. It weighs about a half ton and can be readily pulled around by hand. A bench saw table with a ¾ h.p. electric motor costs, complete with guards, emery wheel, saws, etc., about $75.00. For lifting I use 12 ft. extension ladders with scaffold brackets and a half-ton Triplex hand hoist. These two pieces of equipment will make an elevator that carries the bucket in a straight line from the mixer to the chute. It is movable at a trifling expense."

Continuing on the subject, she said, "A light truck is advisable, supplemented by three trailers. I use a storage shed with a door at each end large enough for 1200 bags of cement and another shed about the size of three carloads for an office, small tools and building material."

Forms Found Best

On the question of forms, Miss Gleason says, "The forms I have found best and am now using are of wood made in sections 8 by 10 ft. and weighing 300 lbs. each. Forms much heavier than this require too much time to erect."

Asked about her method of placing foundations, this feminine builder said, "We first cut a trench about 1 foot wide and 3 feet deep below the natural lot level. We line the bottom of the trench with precast concrete slabs a foot wide. These slabs, when topped by the concrete floor, furnish the mat foundation that enables a building to ride even an earthquake. On the slabs we erect the wall to the floor level which is 3½ ft. above the ground level. We then dig out the three feet of dirt inside the wall and spread it on the garage side within 16 inches of the floor level and on the laundry side 30 inches down, so as to give good light in the laundry and furnace room, and on the other two sides as high as possible so the house from the front will appear to hug the ground. We do not place the floor concrete until after the first floor is poured and until the sewer is in."

Where utmost economy is required, Miss Gleason omits the cellar, at a saving of 15 per cent. However, in climates where it is necessary to excavate at least three feet for the foundations, she finds that a good part of the expense for the cellar is in the foundation, and that it costs less than $100 extra for the other 3½ ft. of wall to make a cellar 6 ft. 6 in. in the clear, including the 3-inch concrete floor, steel sash and extra grading.

Miss Gleason advocates the attachment of the garage to the house. In her own words, "To build the garage as part of the house saves a lot of room, and though nothing is built over it, the cost of one long wall is saved. My design furnishes not only that, but a large second story room at the expense of only three walls and a floor. In addition, the extra length of the garage makes possible a projection for the range that gives us a kitchen long enough to combine a breakfast room with it."

Getting down to details on the superstructure, Miss Gleason approaches first vestibule problems. She says, "The vestibule is a necessary item in our climate and gives extra closet space. Unless the building code requires a foundation for the vestibule, it is more economical and more efficient to erect it on a wide slab. The entrance is in the center so that the end of the living room with its two windows could be easily partitioned off for a first floor bedroom.

Pouring and Finishing the Floor

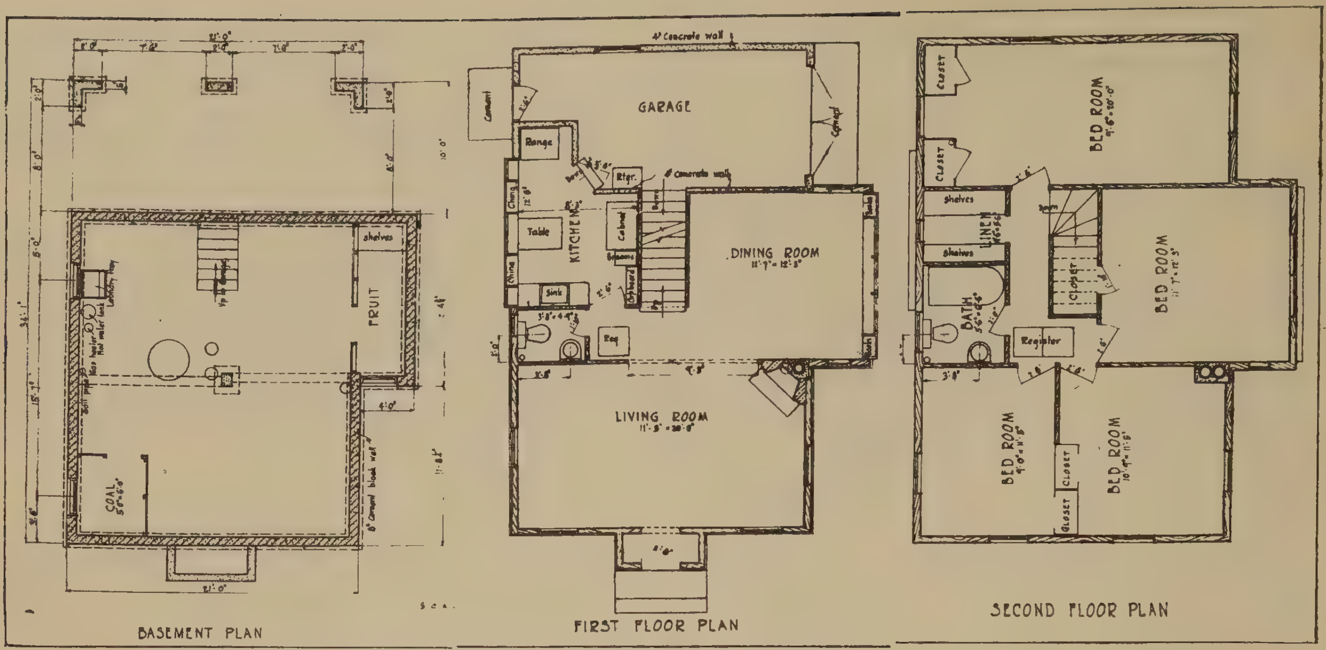
Miss Gleason pours the concrete floor 4 inches thick and reinforces it with welded wire mesh supported by an 8-inch sq. column and an 8-inch "T" beam. It is leveled as it is poured with a sidewalk finish. On the following day, when it will bear a man's weight without footprints and before it has had time to harden against nails, it is covered with low cost asphalt roofing over which a 1-inch sub-floor of the cheapest grade of lumber is nailed to the concrete. The asphalt paper protects the sub-floor from dampness while the concrete is curing. When all rough work on the house has been done and the floor is ready for finishing, an oak strip covering is nailed to the sub-floor. The kitchen and lavatory are finished with linoleum instead of sub-floor and oak top. The cost of the paper and the two floors is figured at 10 cents a square foot, outside of the small cost of laying. This, Miss Gleason says, is less than half of anything she has tried in a smooth hard finish concrete or linoleum. She finds, also, that the oak top invariably gets a good reception.

Kitchen Plan

The kitchen, Miss Gleason says, is her chef d'oeuvre. Here she has gone to more than her usual pains to achieve perfection. The double window she designs deep enough for a window conservatory above the table. The latter has space enough around it to serve meals without interfering with passage. There is a closet in the wall. Walls are poured concrete. The kitchen door leads directly to the cellar way, to the refrigerator and to the back door through the garage.

Continuing to the dining room, Miss Gleason says, "The dining room has a bay 4 ft. by 12 ft. walled with windows which transform the room into a sun parlor as well. I find that I can furnish this two-story projection and equip the lavatory and build the vestibule for $8 less than I could build the ordinary 8 by 10 ft. front porch. The fireplace is precast concrete around a Franklin stove. The flue for the furnace is built on the concrete floor of the living room. As this is strong enough to carry the weight of the chimney, we save the expense of going down the other 7 feet to the cellar floor."

The laundry, lavatory and bath are lined up so as to make the fittings interchangeable from one house to another, Miss Gleason says. The soil pipe is in the corner and it clears the beam in the laundry. Both lavatory and bathroom closets are centered 2 feet from the wall to accommodate without cutting the standard fitting, closet to soil pipe. Basins are centered 42 inches from the wall. Heavy bathroom fittings run along the outside wall where they do not interfere with floor beams and the smaller connection from basin to soil pipe takes only a small cut



in one beam at the point where it is supported by the partition wall.

Leading to the second floor Miss Gleason has an arched entrance stairway which can be shut off with a curtain when it is desirable to retain all heat on the first floor.

According to Miss Gleason, the upstairs hall is lit by the window from the linen closet and the linen closet is wide enough for closed shelves on each side. There are four bedrooms. The room 20 feet long with light on three sides gets its heat through the stair well. The register directly above the furnace takes care of the other three and the bathroom. Some years ago Miss Gleason tested, side by side, a pipe furnace and a pipeless that were products of the same firm and since has been using the pipeless. Closets in the partition wall between two of the bedrooms are standard steel lockers, double size and finished in enamel. Bathtubs Miss Gleason buys with legs but takes them off and builds in the tub.

On the subject of walls, Miss Gleason says, "The wall of the garage and of the range are poured concrete. But for the balance of the first floor and the entire second story I find that applied concrete is cheaper for the outer walls. The amount of hemlock needed for studs and plates costs only $40 at the present retail market price delivered to the job. With a fireproof outer covering and a fire resisting inner wall, the fire hazard is very small and I have therefore not yet studied the possible economy of a steel frame. We use 14 foot 2-by-4's cut in 6 ft. 10 in. and 7 ft. 2 in. lengths. With the floor plate 2 inches for the first story and a double header 4 inches and exposed floor beams 8 inches, we get a total height of 8 feet, which complies with all building laws I have seen."

Miss Gleason continues, "The windows are fitted to the frames before erection and the frames are fitted as the studs are placed. Stretchers or cripples are nailed between studs at 4 ft. above the floor level. They stiffen the frame and make a dead air space. Their particular advantage to my work is that the 4 ft. wide Celotex which I use for the inside finish can be nailed to them along its greatest length. I design all wall spaces about the 8, 10 and 12 ft. standard lengths of Celotex so as to avoid vertical trim. I place a small horizontal band about the height of a chair rail around the entire room."

Insulation

Miss Gleason is an ardent believer in insulation. She declares that she has found that an unheated house that is lined has a temperature of 50 degrees when that outside is 30 degrees. On outside walls she uses a sheathing of heavy asphalt roofing, and over that about 2 inches of cement stucco on a base of steel fabric. The reinforcing is plastered by hand with a rough thick coat of concrete. After drying thoroughly for several days to show shrinkage cracks, the coat is given a light finish.

Regarding purchasing, Miss Gleason frankly says, "Beside my mistake in buying cumbersome machinery, I have found it is bad economy to buy everything in quantity. In hardware I have lost 40 per cent by theft and of lumber 30 per cent by theft and waste. It is safe to buy cement, reinforcing and other materials, such as insulation, in large lots. I now buy lumber by contracting for it in carload lots through a nearby lumber yard who will deliver it in small lots as wanted."

Products Association Accomplishments

(Continued from Page 26)

most for an industry at large. Nevertheless, I do not see why, with 4200 plants in the United States, there are not 1000 plants that could put in $100.00 or even $50.00 for national advertising and educating our clients. It seems to me that while we are making many more products than in the past, only a portion of the possibilities have been realized. The trade association has been aptly termed the bargain counter of business knowledge, where the individual may exchange his experiences for the wisdom of the entire industry. Through such bodies small firms secure some of the advantages usually inherent only in large aggregations. Since the success of the trade association movement depends so completely on full individual participation, it is imperative that business men study closely the co-operative achievements of others.

For my own part I am very anxious to see the association a success; but without work it can never be a success. I realize for one that my efforts are of little avail this season but my understanding with the directors was that I would be more or less of a treasurer and only to handle funds as they come in, which has been a very small job up to this date. We all have our own individual businesses to take care of and these naturally come first; nevertheless, some time should be devoted to association work as before mentioned.

Painless Bookkeeping For Products Plants

The Second Article of a Series on a Simplified Method of Keeping Products Plant Records—Sales Records Are Explained in This Article

By F. W. SCHNOEBELEN

Part II—Sales Records

IN the first article of this series on simplified, time-saving methods of bookkeeping for products plants, production records were explained. Four simple forms—(1) The Daily Time Sheet, (2) the Pay Roll Time Sheet, (3) the Daily Production Sheet, and (4) the Monthly Production and Perpetual Inventory Record—were illustrated and their uses described.

It was shown that these four simple forms contained all the information necessary for a complete understanding of the production end of a products plant. A typical month's business was recorded and analyzed.

This month the sales records are taken up and they will be followed next month by a discussion of the office bookkeeping methods.

SALES records should contain all the necessary information, from the estimate of the job until it has been invoiced and recorded in the sales journal. In addition, they should contain a daily itemized inventory record in order to determine the number of units sold for the period. This record will help in figuring your inventory. These records must not be burdensome or lengthy, and it should take only a few minutes daily to make the necessary notations.

I am going to show you a simple and yet a very accurate method of taking care of the sales which has proved its worth in many ways. This article is written for those who keep no records, or are desirous of improving their present methods.

Estimate and Order Sheet

Exhibit B.1 and B.1A is an example of an estimate and order sheet. A very convenient size for this sheet is 8½ by 10¾ in. It should be in colored stock (a light blue or yellow does very well) which may be bound in book form or loose leaf style. These forms, bound in books of 500, are preferred by the writer. They may be filed away easily for future reference when completed. You will note that the sheet is perforated at the line A.A, the right of the line being the order blank and the left the estimate.

All orders should be numbered for it is much easier to refer to a number in your daily office routine than to refer to the address or the buyer's name. In Exhibit B.1, the number is 46. Notice how this number is carried through the sale on all forms that pertain to it.

The first four lines on the order sheet are self-explanatory. Under the heading "Dimensions," the necessary items are listed. When these are properly filled in, you can estimate the job. The size, height, the number of corners, windows, and the size of the window lights, enable you to get the proper length of the sills, and other openings. At the bottom of the sheet, a blank space is left under the heading "Alterations." Sometimes a contractor or buyer changes some part of the building before or during construction and any such change should be recorded in this space.

On the left hand side of the estimate you will notice that the same information is called for as on the order sheet. This should be filled in as soon as the order blank has been made out. On the right hand side of the estimate sheet, the estimate of the job is tabulated. It will be unnecessary to explain how this job is estimated from the dimensions.

The material is then delivered as estimated and notations are made on this sheet as deliveries are made. For example, if you deliver the 24 corners and 90 plain blocks on the first load, then draw a line through the 24 corners and place a small 90 before the 540 on the estimate sheet. By using this method you can tell at a glance what has been delivered, and what is yet to be delivered.

If there is a difference between the amount of the estimate and the amount delivered, due to a change in the plans, you should make the necessary notations under the heading "As Delivered." This is very essential in order to have a true history of the job. After the job has been estimated and before it is delivered, it should be checked by another party in the office to insure absolute accuracy. If the job is overhauled, the blocks will have to be returned to the yard, which means an extra cartage charge. On the other hand, if the job is underestimated and underhauled, the mason will lose time in waiting for more material, which will seriously damage your reputation and cause lack of confidence in your service.

When the estimate has been made, the order sheet should be torn off at the perforated line A.A. and posted to a bulletin or order board in the office. By placing these orders on a board hanging in the office, you will know at a glance on how many jobs deliveries are being made. This is much easier than leafing through a group of orders on a clasp when making up your loads. As soon as the job is completed, take the order off the board. It may then be destroyed or filed as you see fit. The estimate sheet may be used to another good advantage, namely, for submitting bids. For instance, a contractor calls at your office and wants an estimate on a building. Insert a

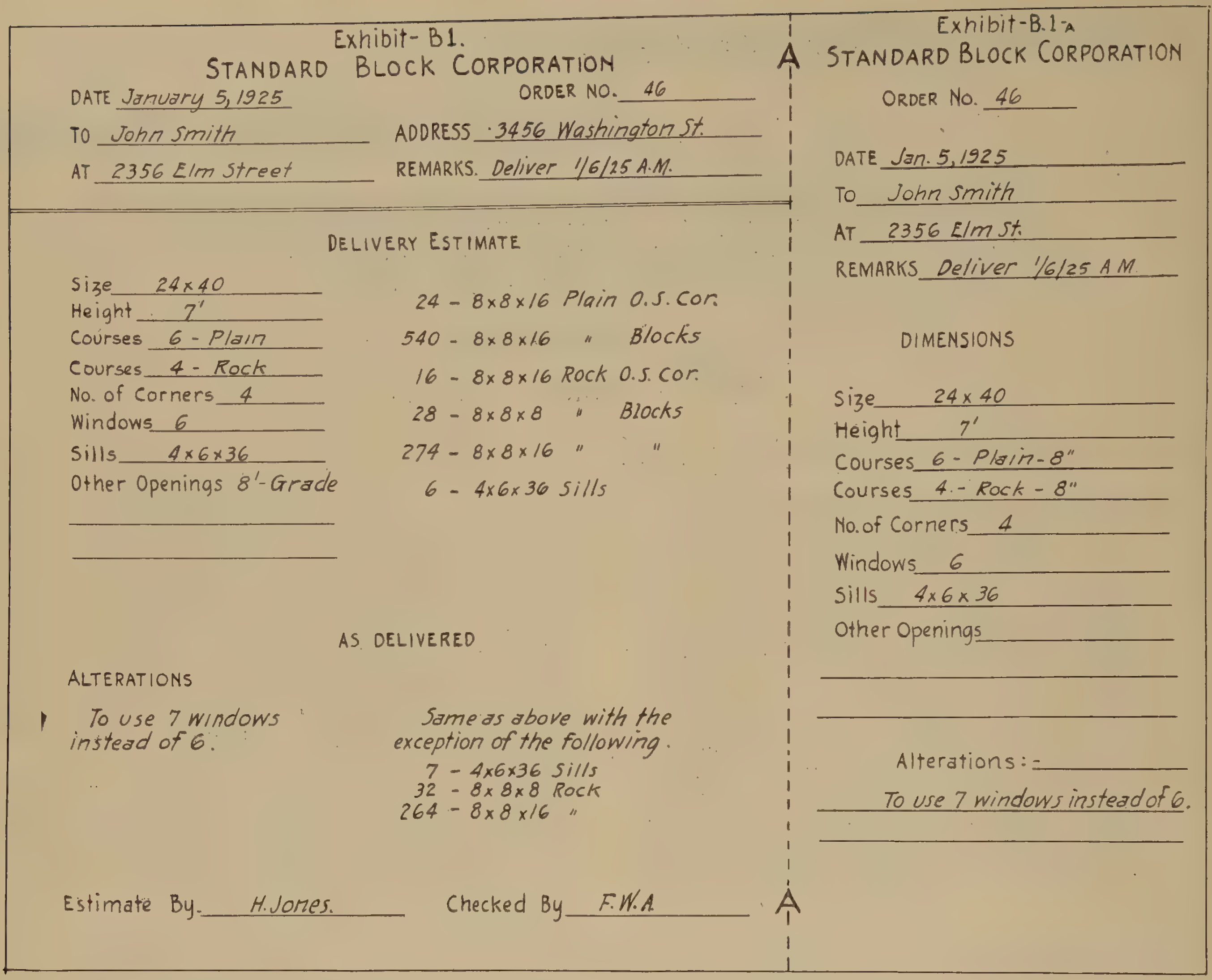


Exhibit- B1.

STANDARD BLOCK CORPORATION

DATE *January 5, 1925*

ORDER NO. *46*

TO *John Smith*

ADDRESS *3456 Washington St.*

AT *2356 Elm Street*

REMARKS. *Deliver 1/6/25 A.M.*

A

DELIVERY ESTIMATE

Size *24 x 40*
Height *7'*
Courses *6 - Plain*
Courses *4 - Rock*
No. of Corners *4*
Windows *6*
Sills *4 x 6 x 36*
Other Openings *8'-Grade*

24 - 8 x 8 x 16 Plain O.S. Cor.
540 - 8 x 8 x 16 " Blocks
16 - 8 x 8 x 16 Rock O.S. Cor.
28 - 8 x 8 x 8 " Blocks
274 - 8 x 8 x 16 " "
6 - 4x6x 36 Sills

AS DELIVERED

ALTERATIONS

To use 7 windows instead of 6.

Same as above with the exception of the following.
7 - 4x6x36 Sills
32 - 8x 8x8 Rock
264 - 8 x 8 x16 "

Estimate By *H. Jones.*

Checked By *F.W.A*

A

Exhibit-B.1-A

STANDARD BLOCK CORPORATION

ORDER No. *46*

DATE *Jan. 5, 1925*
To *John Smith*
AT *2356 Elm St.*
REMARKS *Deliver 1/6/25 A.M.*

DIMENSIONS

Size *24 x 40*
Height *7'*
Courses *6 - Plain - 8"*
Courses *4 - Rock - 8"*
No. of Corners *4*
Windows *6*
Sills *4 x 6 x 36*
Other Openings

Alterations :-

To use 7 windows instead of 6.

carbon paper between two estimate sheets, figure the job, then multiply each unit at the market price and foot the total. Give the contractor the original, keeping the duplicate. In case you receive the order, the carbon serves as a bid record as well as an estimate sheet.

Delivery Records

There are numerous methods of keeping tab on the material as it is delivered. A good method is by means of the delivery receipts, which may be of various sizes. The most convenient form is a 4- by 6-in. sheet in triplicate, which should be of three different colors and numbered one, two and three respectively. The ticket should contain a serial number, blank space for buyer's name and address and a series of blank lines to write the amount and the size of the unit delivered. At the bottom of the delivery ticket, there should be a space for the driver's name, the truck used, and the time the truck left and returned to the yard.

Probably the most important part of the delivery record is the signing of the receipt by the buyer. A blank line is provided at the bottom of the sheet for the contractor's signature. When this is signed properly, it is your receipt for the material. The contractor should sign his full name and not his initials. When one of the buyer's employees signs for him, the signature should be as follows, if John Smith is the buyer and W. Jones is his helper: "J. Smith by W. Jones." If the record is not signed in this manner, the ticket will not be valid at law, should a controversy arise.

As stated before, the delivery receipts are in triplicate. After the ticket is made out it should be recorded in the delivery book, which will be explained in detail later. Delivery receipts number one and two are given to the truck driver, who has the contractor sign number one when he delivers the material. He in turn gives the buyer number two as his record of the delivery. The driver then returns number one to the office, where it is filed with number three until the job is completed and ready to be invoiced.

The Delivery Sheet

Exhibit B.2 is an example of a delivery sheet, which should be in book form. This is called the delivery book. The heading of the sheet explains itself. You will notice that the number of the order is also carried on this form, together with the day the job was completed and the date it was invoiced. There are four items to fill in on this sheet: the date of delivery, the ticket serial number, the size and the kind of unit and the number of units of each on the load. This entry should be made in the delivery book from the delivery receipt before the ticket is given the truck driver. If this is neglected and forgotten, it might cause the job to be overhauled. The check on the amount delivered is made on the sheet, which is compared with the estimate.

So far we have seen how the order was taken from John Smith, an estimate made of the job, and delivery made.

You are now ready to invoice the job. The job was completed on January 8th, according to the delivery sheet. Some firms prefer to mail out invoices daily, while others do this monthly. In this particular case, we will invoice the buyer on the 15th and 30th of the month. The invoice for the job under discussion was sent out on the 15th of the month. This is also recorded on the delivery sheet.

The invoice should contain the number of the order, the date of each load delivered, the ticket serial number, the number and size of each unit, the price per unit and the total, as illustrated in Exhibit B.3. It should be made in triplicate. The original is mailed to the buyer, the duplicate filed in the office for ready reference and the triplicate is filed with the delivery receipts.

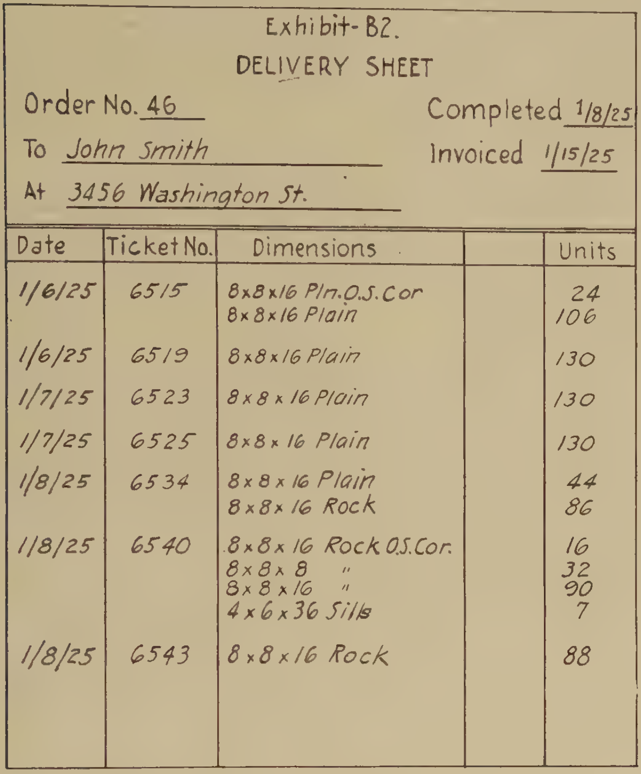


Exhibit- B2.

DELIVERY SHEET

Order No. 46
Completed 1/8/25
To John Smith
Invoiced 1/15/25
At 3456 Washington St.

Date	Ticket No.	Dimensions		Units
1/6/25	6515	8x8x16 Pln.O.S.Cor		24
		8x8x16 Plain		106
1/6/25	6519	8x8x16 Plain		130
1/7/25	6523	8x8x16 Plain		130
1/7/25	6525	8x8x16 Plain		130
1/8/25	6534	8x8x16 Plain		44
		8x8x16 Rock		86
1/8/25	6540	8x8x16 Rock O.S.Cor.		16
		8x8x8 "		32
		8x8x16 "		90
		4x6x36 Sills		7
1/8/25	6543	8x8x16 Rock		88

Before the job is invoiced, always check the delivery receipts with the entries on the delivery sheet, in order to correct those entries. This will reveal any item that has not been entered. The delivery receipts on each job should then be filed with a triplicate of the invoice as mentioned above. The procedure in making out the invoice is as follows: Insert the blank triplicate in the typewriter, open up the delivery book to the delivery sheet on the particular job to be invoiced, and take the loads off one at a time. All the data on the delivery sheet is tabulated on the invoice, such as the date, the ticket number, size of the units and the number of units in each load. In addition to this, fill in the price per unit and then the total amount of each load.

By studying Exhibits B.2 and B.3 carefully, you will see how the delivery sheet and invoice interlock. An accurate method of checking the units is by totaling the number of units on the delivery sheet and comparing them with the total on the invoice. If they are the same you have made no mistake in the transposition of the figures. Through the correctness and the appearance of your invoice you are able to make an impression on your customer. All invoices should be rechecked before they are placed in the mail, in order to insure absolute accuracy. Some firms have built up reputations on this point alone, and their trade very seldom check their invoices, because of their years of dependability. The invoice should be placed in the mail promptly, and if any discrepancy should arise, it should be taken care of immediately and treated in a diligent manner. This is necessary in order to maintain high business standards and good will among your trade. You want your customers to look up to your business as a permanent institution, where they will receive fairness in all their dealings. Not only strive to sell your material, but your honesty and good, sound business principles as well.

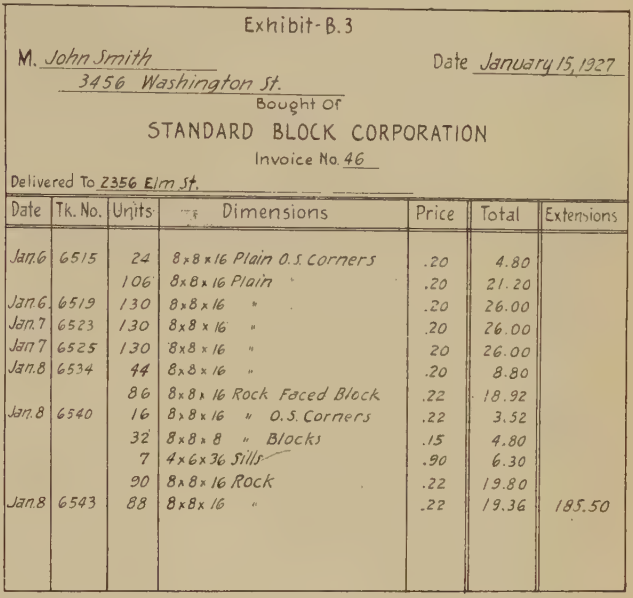


Exhibit- B.3

M. John Smith
3456 Washington St.
Date January 15, 1927

Bought Of

STANDARD BLOCK CORPORATION

Invoice No. 46

Delivered To 2356 Elm St.

Date	Tk. No.	Units	Dimensions	Price	Total	Extensions
Jan.6	6515	24	8x8x16 Plain O.S. Corners	.20	4.80	
		106	8x8x16 Plain	.20	21.20	
Jan.6	6519	130	8x8x16 "	.20	26.00	
Jan.7	6523	130	8x8x16 "	.20	26.00	
Jan 7	6525	130	8x8x16 "	20	26.00	
Jan.8	6534	44	8x8x16 "	.20	8.80	
		86	8x8x16 Rock Faced Block	.22	18.92	
Jan.8	6540	16	8x8x16 " O.S. Corners	.22	3.52	
		32	8x8x8 " Blocks	.15	4.80	
		7	4x6x36 Sills	.90	6.30	
		90	8x8x16 Rock	.22	19.80	
Jan.8	6543	88	8x8x16 "	.22	19.36	185.50

Daily Sales and Inventory Record

We have thus far, in treating with sales, confined our discussion to the buyer. Every manufacturer should know daily the amount of material sold, the kind of each unit and its terms in standard units or tons. This can be recorded in a Daily Sales and Inventory Record (Exhibit B.4). Each sheet, which is 12 by 24 in. contains one month's sales. The sheet is ruled in columnlar form, one for each particular kind of unit sold. These in turn are classified into general divisions or distinct kinds of block. For instance, under the general division "plain standard blocks," all the different dimensions of plain blocks are listed. The daily sales total of the materials sold run lengthwise on the sheet and the monthly amount of each unit sold runs horizontally. The total number of each particular unit sold must be known if a perpetual inventory is to be kept. This will be discussed in a later article.

You will notice from Exhibit B.4, that 1394 units were delivered on January 1st. This figure does not represent the number of pieces delivered, but the number of 8- by 8- by 16- plain blocks (which is taken as the standard unit in this particular case). The figure is arrived at by taking the market price of the 8- by 8- by 16- plain blocks, which is 20 cents as standard. By studying the exhibit you will notice that there were 320 8- by 12- by 16- plain delivered on the above mentioned date of which the market price is 25 cents. Three-hundred twenty 12-in. blocks multiplied by 25 cents is equal to $80.00, which in turn is divided by 20 cents, the market price of 8-in. plain which is equal to 400, the equivalent in 8- by 8- by 16- plain blocks. In the same manner every item delivered on that day is treated.

A perpetual inventory record of sales is kept in the same manner as the production record, which was explained in the previous article. The method is again described in order to make it more familiar. The last three columns on the right of the Daily Sales and Inventory Record are the Total units, that is, the amount of each particular kind of unit produced. The Inventory Cost is

Exhibit B-4
THE STANDARD BLOCK CORPORATION
THE DAILY SALES AND INVENTORY RECORD.

January	1	2	3	4		27	28	29	Total Units	Invt. Cost	Inventory Value.
Plain Blocks											
8 x 5 x 16		230					67	567	1604		
8 x 8 x 16	480		564	301		156	4		15,591	.15	2338.65
8 x 8 x 16 Cor.	28		42	18					805		
8 x 10 x 16		982	69			1678	167	789	1,113		
8 x 10 x 16 Cor.		62				106	6	76	49		
8 x 12 x 16	320	1006		130			190	309	2,176		
8 x 12 x 16 Cor.	36		10			178	18	5	124		
8 x 12 x 8				71			18		131		
8 x 10 x 8		78	11						157		
4 x 8 x 16			106						203		
4 x 10 x 16	80		14						169		
4 x 12 x 16				20				31	83		
Rock Faced											
8 x 8 x 16	240		256	134		97		9	4,323		
8 x 8 x 16 Cor.	16		18	14		11			284		
8 x 10 x 16		321				567	47	183	622		
8 x 10 x 16 Cor.		30				36		8	57		
8 x 8 x 8			28						50		
8 x 10 x 8	14	27				47	9		642		
4 x 8 x 16			14						34		
4 x 10 x 16		34					28	24	260		
Pier Blocks											
9 x 12 x 12			16				8		48		
9 x 16 x 16	24								93		
9 x 20 x 20				30					45		
Chimney Blocks											
8 x 8 flue			35					40	1,500		
8 x 12 flue		60				40			3,480		
12 x 12 flue				42			60		1,020		
Pier Caps											
4 x 18 x 18	3								18		
4 x 14 x 14			2				1		12		
4 x 22 x 22		4		3				3	14		
Chimney Caps											
8 x 8 Flue	1		2			2		1	9		
8 x 12 Flue		1	1				3		17		
12 x 12 flue				1		1		1	3		
Foundation Blocks											
8 x 8 x 8	3		4			4			87		
Sills											
4" x 6" per foot		32	40			18	35		557		
4" x 9" " "									106		
4" x 11 " "	18								693		
MISCELLANEOUS											
Wall Coping				35				98	184		
Specials	3		2					19	29		
Ornamentals								2	3		
Closeouts			45						61		
Daily Totals	1394	3371	1274	1135		3142	976	2474	30,943		3713.00
Remarks:	Building permits were in excess of January last year.										

To be filled in with Inventory Price

Fill in the sum of Total Units by the cost as illustrated.

the cost price of each unit. The Inventory value is the product of the total units multiplied by the cost. For example, there were 15591 8-in. block sold during the month. This, multiplied by the cost price of 15 cents, is equal to $2,338.65, the inventory value. In like manner we treat every item on the sheet and foot the total, which is $3713.00—the inventory value of all the units sold. This figure we will use again, when, in a later article, we determine the inventory of manufactured stock on January 31st.

Under the heading "Remarks," the blank space can be used for various purposes, such as the weather conditions for the period, the number of building permits issued and a general summary of the sales.

The Daily Sales and Inventory Record sheets should be in book form with a year's supply in a book.

Seventeenth Annual Safety Congress Meets in New York City

The Seventeenth Annual Safety Congress of the National Safety Council was held in New York City on the first five days of October. Five hotels housed the assemblage.

Major Henry A. Reninger of the Lehigh Portland Cement Company was elected president of the council.

Nature's Expansion Joints

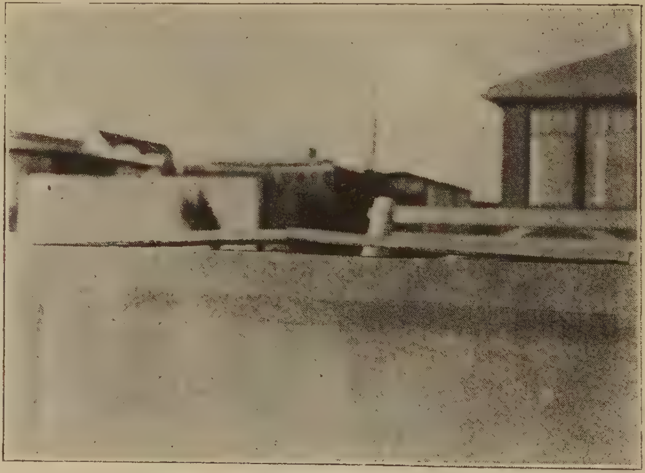
By JAMES R. GRIFFITH

I have heard many engineers discuss the merits of expansion joints in concrete structures. There seem to be many who question the need of such joints. The joints are frequently placed in an arbitrary manner with little thought for the needs of nature. Like many other problems of design, we can frequently learn much by watching nature at work.

Among the interesting things I observed on a motor trip to the Pacific Coast this summer, was nature at work making her own expansion joints. The location was Mission Beach, California, near San Diego. The structure was a new sea wall.

If the function of an expansion joint is to allow for the expansion and contraction of materials, the daily range of temperature in San Diego suggests an ideal condition for observing their action. The nights are so cool that house heating is almost essential for comfort. The heat of the mid-day sun makes concrete and sand almost too hot to touch.

Viewed by thousands daily, appearance was a factor in the design of the Mission Beach sea wall. No unsightly form marks were visible. The entire exposed portion of the sea wall had apparently been carefully plastered. Customary expansion joints had been placed about a hundred feet apart. The photograph shows one form of expansion joint in the making. The 8-in. top of the wall had a ¾-in. plastered finish. The mass of the wall, cool from the preceding night, kept the lower fibers of this finish cool. The hot sun's rays began to expand the upper fibers. The result—identical to the day arching of concrete highways. In this case the bond between the finish and wall long prevented visible rupture. A little today. More tomorrow. Finally a separation. The photograph was taken at noon of an unusually hot July day. The arch, if it may be so called, occurred half way between expansion joints with a span of ten feet and a rise of one and one-half inches. Living in the cottage visible in the photograph at the right, I had an opportunity to observe the arch carefully. By sun-down the slab was back in place. It was up again the next day but with only a total rise of one-half an inch. Down again that evening. Up again the next day but hardly noticeable. The concrete had crushed at the end and crown cracks till sufficient play had been provided by nature for expansion purposes. Judging from the visible cracks in the entire length of wall, nature had just about completed quite a contract.



Effect of Quality of Portland Cement Upon the Strength of Concrete

A Report on Tests Conducted Jointly by the Michigan State Highway Department and the Bureau of Public Roads—Strength of Concrete Varies with Character of Cement Used

By F. H. JACKSON
Engineer of Tests, Bureau of Public Roads

DURING the last several years portland cement concrete has been the subject of a great deal of study. Many tests have been made to determine the effect of such factors as quantity of water, quantity of cement, character and gradation of aggregates, etc., on the quality of the product. However, the effect of the quality of cement upon the quality of the concrete has received very little attention, the tacit assumption being, apparently, that any variations in the quality of the cement would be of relatively small importance, insofar as the quality of the resulting concrete is concerned, provided the cement passed the minimum requirements of the American Society for Testing Materials.

The results of tests made jointly by the Michigan State Highway Department and the Bureau of Public Roads at the Ann Arbor laboratory of the former and presented in this report show that such an assumption may not hold under all conditions, and call attention to the desirability of studying those factors, including the cement, which affect the rate of hardening of paving concrete, because of the economic importance of this feature in influencing the time necessary to keep the completed pavement out of service.

Although the number of specimens subjected to tests was not large enough to justify general conclusions, their remarkable consistency points strongly to the probability that the strength of concrete in tension, flexure, and compression varies directly with the tensile strength of standard 1:3 mortar briquettes made of the cement and Ottawa sand. They indicate also that the strength of a concrete pavement at the end of the customary curing period may or may not be as great as the assumed strength, depending upon the character of the cement used, all other elements being the same.

It is now quite generally recognized that the tensile and flexural strengths of concrete are of more significance than the crushing strength in determining the value of the product for use in pavement construction. Other things being equal, the distance apart at which transverse cracks will form in a plain concrete pavement will vary directly with the tensile strength of the concrete. Moreover, modern methods of design utilize the flexural strength of the concrete as a basis for calculating the thickness of pavement necessary to carry the maximum loads which will be allowed upon it. Unless traffic is restricted the maximum load is just as apt to come upon the pavement the day the road is opened as at some later period. Therefore, the critical strength of the concrete is the strength which it has attained at the time traffic is allowed upon the pavement. Any increase in strength which the concrete may attain subsequently should, in general, be considered only in the light of an additional factor of safety and should not be utilized in design. This, of course, assumes that there will be no retrogression in strength at any later period. The rate of hardening, therefore, becomes an important item and should control the time necessary to keep the pavement closed to traffic.

It was for the purpose of determining the effect of variations in the quality of certain portland cements used in the state of Michigan upon the strengths of paving concrete at the end of the curing period, as well as the relative rate of increase in strength up to and subsequent to this critical stage of the pavement's history, that the co-operative investigation was undertaken.

Character of the Cement the Only Variable in the Tests

All concrete specimens used in the study were of the standard paving mix used by the Michigan State Highway Department, which is 1:2:3½ by volume. The only variable was the quality of the portland cement, of which three grades were used—a slow-hardening grade with a briquette strength averaging about 200 lbs. per sq. in., a grade of medium strength running about 250 lbs. per sq. in., and a cement of fairly high early strength testing approximately 300 lbs. per sq. in., all at 7 days.

A single consistency, corresponding to good average paving practice, was used throughout. Typical aggregates, a sand and gravel conforming in all respects to the requirements of the Michigan state highway specifications were employed; and all proportioning, mixing, molding, curing, and testing were strictly in accordance with the practice recommended by the American Society for Testing Materials. The results of routine tests on the three portland cements used are given in Table 1, and the gradation and physical properties of the aggregates in Table 2. Thus far the specimens have been tested at the age of 7, 14, 21, 28, 90, and 180 days. Specimens for one and two year tests have been made and will be tested at the proper time.

TABLE 1

Results of tests on three portland cements used in Michigan concrete tests

	Fineness retained on No. 200 sieve	Setting time				Tensile strength	
		Initial		Final		7 days	28 days
Type of cement	Per cent	Hrs.	Min.	Hrs.	Min.	Lbs. per sq. in.	Lbs. per sq. in.
High strength	18.5	4	10	5	40	325	400
Medium strength	18.7	3	55	5	55	255	380
Low strength	20.0	4	10	6	00	180	315

From *Public Roads*.

TABLE 2

Results of tests of aggregates used in Michigan concrete tests

Sand	
Size:	
Retained on No. 10 sieve, per cent	28
Retained on No. 30 sieve, per cent	75
Retained on No. 50 sieve, per cent	93
Retained on No. 100 sieve, per cent	98
Color	O.K.
Weight per cubic foot, pounds	112
Strength ratio, 7 days	138
Strength ratio, 28 days	135
Gravel	
Size:	
Retained on 1½-inch screen, per cent	0
Retained on 1-inch screen, per cent	30
Retained on ¾-inch screen, per cent	60
Retained on ½-inch screen, per cent	85
Retained on ¼ inch screen, per cent	100
Per cent of wear (gravel test)	5
Weight per cubic foot, pounds	109

Three types of tests have been made—direct tension, flexure, and compression. For the tension tests, cylinders 6 inches in diameter by 21 inches long were cast and tested in accordance with the method first used in the structural materials research laboratory at Lewis Institute, Chicago, (now the research laboratory of the Portland Cement Association), and described in the Proceedings of the American Society for Testing Materials for 1926.* By this method the cylinders are broken in a universal testing machine. The grips consist of two pieces of 6-inch steel pipe lined with leather and split part way along four elements so as to slip over the ends of a cylindrical concrete specimen. The segments are then drawn tight by means of tangential bolts to prevent slipping during the application of the load. Ball and socket joints in each grip make the set-up self-aligning. In general, two breaks were secured from each specimen.

Application of Load

The specimens for the flexure tests were beams 6 by 6 by 36 inches in size, tested as cantilevers by the method first proposed by Clemmer.† The beams are supported as cantilevers and an extension arm with a container at the extreme end placed over the free end of the beam. Load is applied by an even flow of shot or water from a separate container equipped with a quick-acting valve. Calculations to determine the flexural strength involve the overhang of the specimen, the extension arm, and the weight of shot or water required to cause failure. Two breaks were secured from each beam.

The compressive tests were made in the conventional manner on 6- by 12-inch cylinders; and in these, as in the other tests, the specimens were tested immediately on removal from moist storage.

The schedule of tests called for three specimens of each type for each age and for each cement. As it was possible in almost all cases to obtain two breaks from each of the tension and flexure specimens, six values for tensile and flexural strength were obtained and reported for each combination and three values in compression. The results of all tests up to and including the six-month period are given in Tables 3 to 5, inclusive. The average strengths shown in these tables for each of the three cements tested are plotted against age in Figure 1, and in Figure 2 the results of the three types of concrete tests at the age of 7 and 28 days are plotted against the tensile strengths of the cements as shown by 1:3 Ottawa and briquette tests at the same periods.

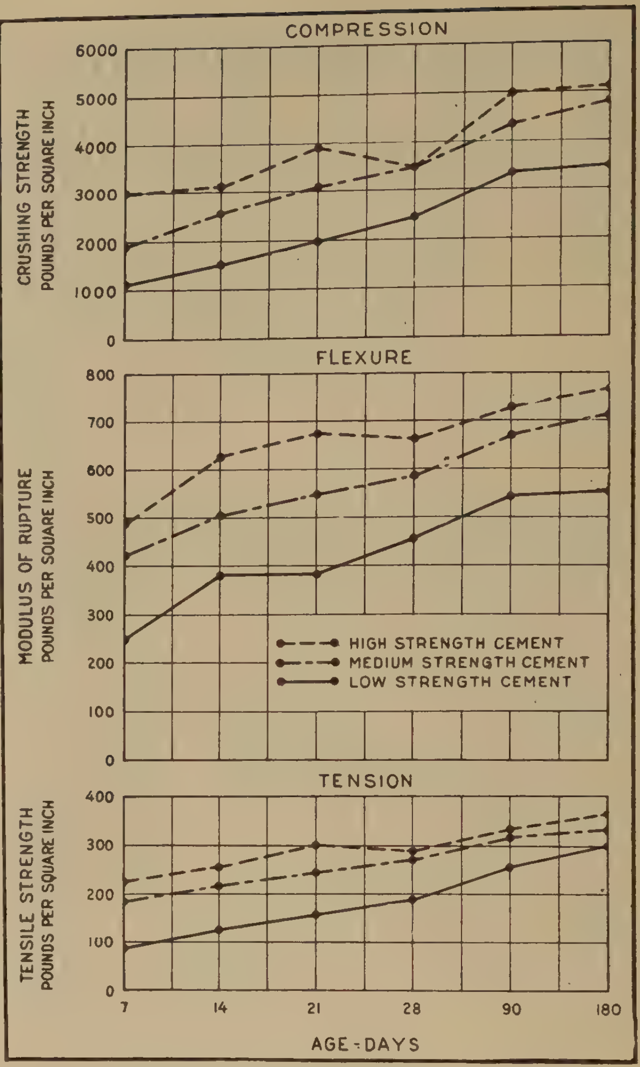


Figure 1. Strength of concrete made from three grades of portland cement

TABLE 3

Results of tests of 1:2:3½ gravel concrete specimens made with high-strength cement

	Age in Days					
Type of Test	7	14	21	28	90	180
Compressive strength in lbs. per sq. in. of 6- by 12-inch cylinders.	3,073	3,400	3,840	3,060	4,900	5,115
	2,890	2,865	3,630	3,995	5,200	5,100
$\frac{W}{C} = 0.76.$	2,970	3,168	4,220	3,310	4,810	5,020
Average	2,978	3,144	3,897	3,455	4,970	5,078
Tensile strength in lbs. per sq. in. of 6- by 21-inch cylinders.	203	-----	297	276	334	371
	-----	232	294	282	314	-----
	224	262	312	303	316	374
	-----	279	300	294	337	363
$\frac{W}{C} = 0.78.$	237	246	282	274	352	352
	235	273	310	263	361	-----
Average	225	258	299	282	336	365
Modulus of rupture in lbs. per sq. in. of 6- by 6- by 36-inch beams, tested as cantilevers.	483	678	542	625	702	781
	465	715	615	668	708	780
	532	664	818	678	745	729
	498	654	858	703	790	684
	462	495	672	665	706	834
$\frac{W}{C} = 0.75.$	497	562	548	620	682	786
Average	489	628	676	660	722	766

Briquette Strength of Cement and Strength of Concrete Related

The effect of variations in the quality of cement upon the strength of the concrete, as shown by Figure 1, appears to be quite marked. Observing the relative values for each of the three grades at the end of the conventional curing period of 21 days, it will be seen that the strength of the concrete containing the high-test cement is approximately double that of the concrete containing low-test cement, and that the concrete in which the medium-strength cement was used runs about midway between. The significance of such wide variations in strength from the design standpoint will be readily apparent.

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*Proc. A. S. T. M., 1926, pt. 2, p. 447.

†Proc. A. C. I., 1926, p. 304.

TABLE 4

Results of tests of 1:2:3½ gravel concrete specimens made with medium-strength cement

Type of Test	Age in Days 7	14	21	28	90	180
Compressive strength in lbs. per sq. in. of 6- by 12-inch cylinders. $\frac{W}{C} = 0.76$.	1,881	2,670	3,435	3,383	4,320	4,762
	1,816	2,540	2,880	3,610	4,390	4,895
	2,000	2,535	2,992	3,500	4,200	4,685
Average	1,899	2,582	3,102	3,497	4,303	4,781
Tensile strength in lbs. per sq. in. of 6- by 21-inch cylinders. $\frac{W}{C} = 0.78$.	194	—	273	297	309	344
	—	207	259	299	303	—
	—	225	215	—	291	315
	—	211	—	246	346	—
	178	222	259	273	329	332
	177	210	206	235	333	—
Average	183	215	242	270	319	330
Modulus of rupture in lbs. per sq. in. of 6- by 6- by 36-inch beams, tested as cantilevers. $\frac{W}{C} = 0.75$.	456	525	487	576	694	743
	430	500	531	554	686	749
	447	544	627	592	666	669
	442	469	568	625	703	664
	376	487	551	591	619	702
	393	495	512	588	639	716
Average	424	503	549	588	668	707

Modulus of Rupture Obtained

If it be assumed that the edge thickness of a concrete pavement has been determined by the corner formula on the assumption that the concrete will have a modulus of rupture of 600 lbs. per sq. in. at the time the road is opened to traffic, it will be found from Figure 1 that, with the aggregates employed and for the conditions obtaining in these tests, the required modulus of rupture was attained in approximately 12 days by the use of the high-strength cement, in somewhat more than 28 days when the medium-strength cement was employed, and that it had not been reached up to six months when the low-strength cement was used. The low-strength cement did not pass the requirements for strength of the American Society for Testing Materials, but if, for this reason, we ignore the results of the tests on the concrete in which it was used, we still find the time required to produce concrete of the required quality to be markedly longer when the medium-strength cement (which passed all A. S. T. M. requirements) was used than when the high-strength cement was employed.

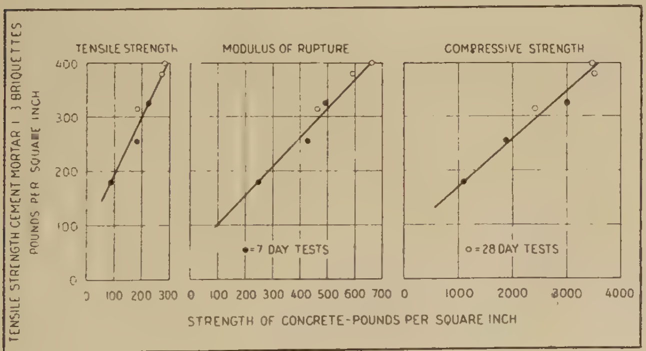


Figure 2. Relation between quality of cement as shown by routine tensile tests of briquettes and the quality of concrete (1:2:3½ by volume) for three grades of portland cement

TABLE 5

Results of tests of 1:2:3½ gravel concrete specimens made with low-strength cement

Type of Test	Age in Days 7	14	21	28	90	180
Compressive strength in lbs. per sq. in. of 6- by 12-inch cylinders. $\frac{W}{C} = 0.76$.	1,051	1,230	2,000	2,482	3,260	4,055
	1,158	1,760	—	2,290	3,412	3,195
	1,150	1,710	1,970	2,470	3,250	3,250
Average	1,120	1,567	1,985	2,414	3,307	3,500
Tensile strength in lbs. per sq. in. of 6- by 21-inch cylinders. $\frac{W}{C} = 0.78$.	—	—	143	158	240	305
		112	174	210	285	—
	86	—	155	196	253	314
	—	124	166	196	—	309
	89	145	162	189	262	275
	88	—	150	174	225	—
Average	88	127	158	187	253	301
Modulus of rupture in lbs. per sq. in. of 6- by 6- by 36-inch beams, tested as cantilevers. $\frac{W}{C} = 0.75$.		442	337	428	570	558
	255	450	341	524	599	587
	222	332	435	423	519	529
	244	359	449	456	571	537
	252	377	361	486	486	585
	268	345	372	447	410	520
Average	248	384	383	461	543	553

Briquette and Concrete Tests

Referring now to Figure 2, it will be observed that there is a very interesting relation between the results of briquette tests on the three cements at 7 and 28 days and the results of the various concrete tests at the same periods. There appears to be a very definite relation between briquette strength and concrete strength at corresponding ages. This relation, moreover, applies to all three types of concrete tests. It will not be asserted, of course, that these results are sufficient to warrant any conclusions of a general nature. It is believed, however, that the meagerness of the data presented is to a certain extent balanced by the remarkable concordance of the results obtained, so that they may be said to be at least indicative and, therefore, of value in suggesting a field for additional and more extensive research.

Large Concrete Slab Supports Building Above Tunnel

Sixty feet of earth separated the footings of the 27-story Northern Life Tower Building in Seattle, now under construction, from the tunnel of the Great Northern railway. The tunnel runs directly under the building. To circumvent possibility of trouble there has been just completed the casting of the heaviest slab of concrete over the tunnel ever poured in Seattle, it is said.

The slab contains 1600 cubic yards of concrete and 100 tons of reinforcing steel. It measures 104 by 80 feet and is 4 feet 7 inches thick.

Work of pouring the slab required 24 hours of continuous operation. Twelve trucks hauled the wet concrete from a central mixing plant out of the central business district of the city to the pit and there dumped the material into six bins from which it was chuted into the slab.

During the continuous pouring operation crews worked at night.

From the Products Associations' Bulletins

Nebraska Concrete Products Association

ROGER MERRITT, Secretary

OLD homes, neglected homes, fire-trap homes, will all be new, modern and marketable homes if the work of the local Home Modernizing Bureaus gets under way with the same enthusiasm that is being shown by the Nebraska association in helping to promote the formation of local bureaus, for the present, in Nebraska's largest cities. And the leaders among products men are getting right back of this new organization full force. Others are urged, in this issue of the bulletin, to become members of the bureau. They are assured that whatever is put into the development is to be regarded as an investment, paying returns many times over.

The September issue of the Nebraska association's news letter goes head first into the subject of cold weather building, with several paragraphs entitled "Increasing Winter Construction." They state in part: "Winter weather has long exacted a toll from the building industries, and winter got away with it because people took for gospel the notion that construction had to be suspended when the first snow flew. Building stopped, labor went idle, money tightened, and enterprises of all types, from public works to bungalows, marked weary time waiting for spring. The loss, in dollars and cents, was staggering.

"But part of that loss can be eliminated. Reservoirs control water supply and prevent drought. Firesafe buildings stem the onrush of fire. . . . Concrete is the dominating element in all these measures. And engineers have shown that winter weather is no bar to construction; as a matter of fact, winter building has its positive economies, especially where cement is used.

"Why not plan now on an active campaign for the coming winter? This can be accomplished not only by manufacturing units to build up your reserve for next year, but also by going out and talking to prospective builders and showing them the economy in doing their construction work during the winter season."

May the Nebraska preacher continue to spread his good gospel!

The Nebraskan products manufacturers recently invested some of their good cash in a state fair exhibit and it seems to have been all to the good, for those in charge believe a "lot of good was accomplished both from personal contacts and from an advertising standpoint," and the fact that it is planned to put more into the same project next year.

Northwest Concrete Products Association

F. R. ZAUGG, Secretary

THE current issue of "The Pre-Cast Product" is a "Literature Edition" and in the way of a campaign to induce the products man himself to digest some of the excellent literature being printed for him on the subject that is his livelihood and the field in which he wants to keep best posted. Most of the literature is, of course, designed for distribution among the public and products men are advised to obtain and broadcast as many copies as they can.

Northwest products men are given their "cue" to assemble data for the 1928 survey of concrete masonry in one of the items. The manufacturer is advised to fill out the card he is to receive requesting the number of units, including block, building tile, brick, caststone, silo staves and manhole block, so that he and others may benefit by the assembled data. It was from statistics such as these, it is stated, that the interesting talk presented by the Portland Cement Association representative at the recent Northwest meeting was based.

The next Northwest meeting will presumably be of, for and by members. Their suggestions as to speakers, improvement of meetings, and others, are invited. Even a blank form to be filled in with the meeting date preferred by the individual member is provided.

Other strenuous culvert competition is seemingly having no effect on the sales of the Spokane Concrete Pipe Co., for it is reported to have secured a large volume this year, in the face of unusually keen competition. But, let it be noted, aggressive sales methods and real selling were necessary.

Wisconsin Concrete Products Association

JACK FRANKLIN, Secretary

"THE Changing World" is the title of an editorial whose theme is "co-operation," in the September issue of the Association's Digest. It begins, "Very few products manufacturers realize the progress and change that is constantly taking place in this 'new business' that they are financially interested in. After all is said and done, we do have to admit that the concrete products business is just beginning to put on 'long pants' and becoming a full grown man. . . . To start with, the type of plants being built and the money behind these plants place the manufacture of products in the line of 'big business.'

"No longer can you sit in your office and be content to have your customers call you to give you an order.

"This is a day of 'competition' and your plant must be in shape to turn out a good product at a low price with a fair margin of profit to you.

"If you don't do it, your competitor will, and it isn't hard to guess as to who will get the business."

Products manufacturers are urged to make their trade marks stand for uniform quality, so that they may earn the reputation of being dependable. "No company is big enough to survive on the principle of getting all it can from a customer."

A pair of paragraphs entitled "Off the Track," say, "Just one wheel off the track and a street car line is paralyzed. A whole street may be blocked and traffic halted.

"Are all the wheels in your organization on the right track? One man off the track, out of tune with the rest of the work and many products stay in the cement sack, the sand bin or the stockpile. The man may be at the machine—an off-bearer—a salesman—the truck driver—the head man himself—it matters not who he is. It pays to take a man power inventory and see that everybody is on the track."

And then go ahead at full speed, it might be added!

Ultimate Strength in Diagonal Tension of Reinforced Beams

Presenting a Formula for Computing the Ultimate Strength in Diagonal Tension of Concrete Beams—Tests

By H. E. PULVER

An examination of the results of tests on reinforced concrete beams which failed by diagonal tension seems to indicate that the ultimate unit strength in diagonal tension (as measured by the unit horizontal shear at the neutral axis) equals the ultimate unit tensile strength of the concrete plus the unit stress at elastic limit (or yield point) of the steel times the percentage of diagonal tension reinforcement.

Expressed as a formula:

$$v' = f'_d + f'_s p_d$$

Where

v'=ultimate unit shear as found by formula $v' = \dfrac{V'}{bjd}$

f'_d=ultimate unit tensile strength of the concrete

f'_s=unit tensile stress of web steel at elastic limit (or yield point).

p_d=ratio of web steel area to concrete area

This formula may be used for computing the ultimate strength in diagonal tension of a reinforced concrete beam.

Results of tension and compression tests on concrete indicate that the concrete is usually from 8 to 10 times as strong in compression as in tension. For computation purposes, the ratio of the ultimate unit tensile strength to the ultimate unit compressive strength of concrete may be safely taken as one-tenth without appreciable error. Then $f'_d = \dfrac{f'_c}{10}$ when f'_c=ultimate unit strength of concrete in compression.

When computing the ratio of the web steel area to the concrete area, the concrete area is equal to the breadth of the beam times the perpendicular distance between the planes in which the web reinforcement is bent. For vertical stirrups, the perpendicular distance is equal to their horizontal spacing (s) along the axis of the beam. For stirrups inclined at an angle of 45 degrees, the perpendicular distance (a) is 0.707 times their horizontal spacing. The web steel area is equal to the cross sectional area of the bent rods or stirrups in any one plane.

This formula cannot be satisfactorily used in computing the ultimate unit stress in shear (as measuring diagonal tension) unless the following conditions are fully met in the design:

1. All tension reinforcement must be thoroughly anchored to prevent a possible bond failure.
2. All web reinforcement must be of such size and so thoroughly anchored as to prevent a possible bond failure. The maximum diameter of a stirrup should not exceed about 1/50 of the depth of the beam.
3. All web reinforcement must not be spaced so far apart as to reduce its effectiveness. A spacing of one-third of the depth of the beam or less is usually satisfactory.
4. When necessary, correction should be made for the effect of T and I sections. In case of a T section with the neutral axis appreciably below the flange, no flange correction is needed.

There is a relation between the total maximum shear and the formula given. This may be shown as follows:

$$v' = f'_d + f'_s p_d$$

multiplying by bjd

$$v'bjd = f'_d bjd + f'_s p_d bjd$$

Now $V' = v'bjd$, and $p_d = \dfrac{A}{ba}$ when A is the cross sectional area of diagonal tension steel in one plane and a is the perpendicular distance between planes.

Substituting

$$V' = v'bjd = f'_d bjd + f'_s \frac{A}{a} jd$$

Tests Check Formula

The best way to determine the correctness of a formula of this type is to check computations made by its use with the results of tests. Unfortunately, there is not much test data available in which the reinforced concrete beams have been so designed as to cause them to fail first by diagonal tension. In most of the test beams the tensile steel was insufficient, or the web reinforcement was spaced too far apart, or else not enough anchorage was provided for the tensile and web steel to prevent bond failures before the web steel was stressed to its elastic limit(or yield point). An initial failure by bond appears to be quite common though the final failure recorded is usually tension or diagonal tension.

In Bulletin 197 of the University of Wisconsin on Tests on Plain and Reinforced Concrete, Series of 1907, by Professor M. O. Withey, some beams were found which failed by diagonal tension. Some of the other beams which failed by tension, were, at the time of failure, very close to a diagonal tension failure as evidenced by the number and direction of the cracks. Two pairs of these beams, pairs E and F, failed by tension before the web reinforcement was stressed as high as the elastic limit or yield point. The beams, of which there are eight pairs, are listed in table 14 on page 134 of the bulletin. Results of tension tests on concrete cylinders made from the same concrete as the beams are also available. These cylinder tensile strengths are used in computing the ultimate unit shearing strength (as measuring diagonal tension) of the beams. While part of these beams were T beams, the neutral axis was far enough below the flange so that no correction of the shear area (due to the flange) was thought necessary. However, beams of the A to D pairs inclusive had some bent up rods which should be allowed for in the computations. It is doubtful as to how much influence on the diagonal tension strength that these bent up rods had, as the ones bent near the supports had practically no anchorage. In the computations, allowance is made only for the bent up rods which had considerable anchorage. These rods were assumed to be bent up at an angle of 45 degrees.

The following tabulation shows the results obtained. Only the average of each pair is tabulated. Pairs E and F are omitted from the tabulation. In beams having both vertical stirrups and bent rods, the unit tensile stress in a bent rod was taken as the unit tensile stress in the stirrup times the cosine of the angle with the vertical.

TABLE I

Ultimate Unit Shearing Stresses in Reinforced Concrete Beams

Bulletin No. 197 of the University of Wisconsin

Beam	Observed shear at ultimate $v'=V/bjd$ lb./in.^{2}	Concrete tensile strength from cylinders lb./in.^{2}	Yield point of web reinforcement lb./in.^{2}	Ratio of web steel stirrups	Correction for 1 bent rod	Computed shear at ultimate lb./in.^{2}	Ratio of observed shear to computed shear
A	359	211	45,000	.0025	.0017	377	0.95
B	355	209	47,400	.0022	.0017	370	0.96
C	319	207	47,400	.0022	.0013	354	0.90
D	535	182	41,300	.0058	.0017	471	1.14
G	260	174	47,400	.0022	0	278	0.94
M	307	176	47,400	.0020	0	271	1.13
Av.							1.00

Beams E and F failed by tension before the web reinforcement was stressed as high as the yield point, and are not included.

Each value is an average value for two beams.

Sample computation: Beam A

Computed unit shear at ultimate=

$$211+0.0025\times45{,}000+0.0017\times0.707\times45{,}000$$

Computed unit shear at ultimate=

$$211+112+54=377 \text{ lb. per sq. in.}$$

The unit stress in a rod bent at an angle of 45 degrees will be equal to 0.707 times that in a vertical rod at the same place.

These beams have only a comparatively small amount of web reinforcement.

Tests on Large Beams

In the Engineering News-Record, Volume 82, No. 9 (Feb. 27, 1919), there are given the results of tests on several large reinforced concrete beams. These beams contained up to about 3.5 per cent of web reinforcement and were designed to give large ultimate unit shearing stresses, which they did. However, these beams were designed with comparatively thin web sections and with comparatively heavy flanges at the top and bottom, besides having thickened web sections at the center of the spans and at the supports. There seems to be no doubt but that these flanges and thickened sections aided in carrying some of the shear (diagonal tension). However, it is difficult to determine just what proportion of shear was carried by these flanges and thickened sections. When the unit shear is computed by the formula $V/b'jd$, the upper flange will not carry much shear while the lower flange will carry shear, say from about the center of gravity of the horizontal steel up to the web. Also, due to the rather abrupt change in thickness where the lower flange begins, it seems doubtful if the unit shear in the upper part of the lower flange will be as large as that in the lower web. It is questionable just how much the heavy flanges and thickened web sections aided in carrying the shear before there had been an initial failure in the web. Consequently, no correction was attempted for the unit shear as computed by formula $V/b'jd$ and tabulated in Table II.

The test data is incomplete in that no results of tensile tests on the web reinforcing steel are included other than the statement that the yield point was approximately 60,000 lb. per sq. in. It may be true that the bars of the smaller sizes (⅜ in. and ½ in. bars) did have a slightly higher yield point (say 5,000 lb. per sq. in. or so) than did the larger sized bars (⅝ in. and ¾ in. bars). If this were true, the computed values of unit ultimate shear would be higher for the beams having ⅜ in. and ½ in. web reinforcement and the agreement with the observed values would be better. The value of 60,000 lb. per sq. in. was used in the computations for the computed unit ultimate shear (as measuring diagonal tension) except that the results in parenthesis are for values of the yield point of 63,000 lb. per sq. in. for the ½ in. web steel and 66,000 lb. per sq. in. for the ⅜ in. web steel.

TABLE II

Ultimate Unit Shearing Stresses in Reinforced Concrete Beams

U. S. Bureau of Standards (Slater) Engr. News-Record, Feb. 27, 1919

Beam	Kind of web reinforcement	Observed shear at ultimate $v'=V/b'jd$ lb./in.^{2}	Concrete cylinder compressive strength lb./in.^{2}	Unit stress in web reinforcement lb./in.^{2}	Ratio of web steel to concrete pd	Computed shear at ultimate lb./in.^{2}	Ratio of observed shear to computed shear
4E	Vertical	1763	5975	41,000	0.0335	1970	0.90
4F	Vertical	1817	5705	52,900	0.0251	1895	0.96
4G	Vertical	1550	5550	60,000 (63,000)	0.0156	1492 (1536)	1.04 (1.01)
4H	Vertical	1298	5925	60,000 (66,000)	0.0082	1085 (1131)	1.20 (1.15)
4V	Diagonal	2310	5120	60,000	0.0351	2612	0.89
4W	Diagonal	1888	5510	60,000	0.0239	1980	0.95
4X	Diagonal	1728	5100	60,000 (63,000)	0.0155	1440 (1484)	1.20 (1.17)
4Y	Diagonal	1423	5230	60,000 (66,000)	0.0087	1045 (1098)	1.36 (1.30)
4AE1	Diagonal	2120	4650	60,000 (63,000)	0.0239	1895 (1967)	1.12 (1.07)
4AF1	Diagonal	1225	4380	60,000 (63,000)	0.0115	1128 (1160)	1.09 (1.06)

Each result is an average for two beams, except for 4AE1 and 4AF1 which were single beams.

Average of ratios gives 1.07 (1.04) which is quite close.

Sample computation: Beam 4E

Computed with shear at ultimate=

$$\frac{5975}{10}+0.0335\times41{,}000=1970 \text{ lb./in.}^2$$

Assumption of Two Parts

Another method of computing the unit shear values would be to assume that these beams had two parts which aided in carrying the shear. These parts are the frame (top and bottom flanges) and the web. If the shear carried by the frame was deducted from the total shear sustained by the beam, the remaining shear would be that carried by the web.

Beams 4AG were a pair of beams which consisted of a frame only and did not have any web or web steel. These beams carried an average shear of 35,650 lbs. Deducting this shear from the total shear carried by a beam which has a frame and a web, gives the net shear carried by the web.

To find the unit shear in the web, this net shear is divided by the area of the web. The quantity, j, is not used in this shear computation, because the effect of the top flange is to remove the upper (and smaller) part of the curve representing the distribution of the unit shear over a vertical section of the beam.

Approximate Method

This method is an approximate one only, but fairly consistent results were obtained when it was applied to the beams in question. The results obtained by this method are tabulated in Table III. It is to be noted that the ratios of the observed shear to computed shear in Table III are practically the same as the corresponding ratios in Table II.

TABLE III

Ultimate Unit Shearing Stresses in Reinforced Concrete Beam

U. S. Bureau of Standards (Slater) Engr. News-Record, Feb. 27, 1919

Beam	Kind of reinforcement	Shear (reaction) lbs. V	Shear carried by web and steel lb. V_1	Web area, sq. in. $b'd_1$	Observed shear at ultimate $v'=v_1/vd_1$ lb./in.²	Concrete cylinder compressive strength lb./in.²	Web steel concrete pd	Computed shear at ultimate lb./in.²	Ratio of computed shear to observed shear	Ratio of observed shear to computed shear
4E	Vert.	169,450	133,800	75.9	1770	5975	0.0335	1970	1.11	0.90
4F	Vert.	160,900	125,250	70.5	1780	5705	0.0251	1895	1.06	0.94
4G	Vert.	144,175	108,525	72.5	1500	5550	0.0156	1492	0.99	1.01
4H	Vert.	129,575	93,925	78.0	1205	5925	0.0082	1085		1.11
4V	Diag.	213,275	177,625	72.5	2460	5120	0.0351	2612		0.95
4W	Diag.	177,025	141,375	73.8	1920	5510	0.0239	1980		0.97
4X	Diag.	160,875	125,225	73.4	1705	5100	0.0155	1440		1.18
4Y	Diag.	132,450	96,800	73.3	1320	5230	0.0087	1045		1.26
4AE1	Diag.	129,000	93,350	47.3	1970	4650	0.0239	1895	0.96	1.04
4AF1	Diag.	153,150	117,500	97.8	1200	4380	0.0115	1128	0.94	1.06

Each result is an average for two beams, except for 4AE1 and 4AF1 which are single beams.

Average unit tensile stress in web steel taken as 41,000 lb./in.² for beams 4E, 52,900 for beams 4F, and 60,000 for others.

Average of ratios gives 1.04.

Further Beam Tests

In CONCRETE for April, 1917, there is published an article entitled "Tests on Ten Reinforced Concrete T Beams" by Professors Braune and Myers of the University of Cincinnati. These beams were constructed with fairly wide flanges and were designed to give high unit shearing stresses.

In the beams of type I, the rods were not anchored, hence the beams probably failed by bond long before the ultimate unit shearing stress (as measuring diagonal tension) of the concrete was reached. In type III, the web reinforcement was bent up in one plane only and, consequently, was not distributed to the best advantage.

The neutral axis of these beams in each case was in the flange. This condition makes it necessary to allow for the shear (diagonal tension) carried by the concrete in the flange.

Considering the formula for a rectangular beam:

$$V'=v'bjd=f'_d bjd+f'_s\frac{A}{a}jd$$

it is seen that in case of a T beam this formula would apply except for the breadth, b, which is not a constant over the depth, d, of the beam. Probably the simplest method would be to obtain an equivalent breadth, b_1, which is more than b', (web breadth) and less than b (flange breadth) of the T beam, and which may be used to replace the value, b, in the formula for a rectangular beam. The formula for a T beam (with a correction made for the flange) will be

$$V'=v'b_1jd=f'_d b_1jd+f'_s\frac{A}{a}jd$$

A simple way of finding this equivalent breadth, b_1, is to consider the T beam as a rectangular beam with portions of the lower part cut away. The value for b_1 will not be an average of b and b' but will be such a value that, when multiplied by v'jd, the product will equal the total shear V'. To find this equivalent b_1 it is necessary to know the dimensions of the beam cross section and the value of j or jd. Considering the lower portions of the beam section cut away:

$$b_1\,jd=bjd-(b-b')\ (d-t)$$

when t is the thickness of the flange.

The following table (Table IV) gives the value of b_1 for the five pairs of beams:

TABLE IV

Beam	jd	bjd	d	d — t	(b — b') (d — t)	bjd — (b — b') (d — t)	b_1
I	9.41	395.2	10.375	6.125	220.5	174.7	18.55
II	9.24	388.1	10.375	6.125	220.5	167.6	18.15
III	9.24	388.1	10.375	6.125	220.5	167.6	18.15
IV	8.65	363.3	9.94	5.69	204.8	158.5	18.35
V	8.65	363.3	9.94	5.69	204.8	158.5	18.35

b=42 in., t=4.25 in., b'=6 in., and b — b'=36 in. for all beams.

The equivalent cylinder unit compressive strength was found by the formula:

$$\text{Equivalent cylinder strength}=\text{cube strength}\ \left(0.778+0.222\,\frac{\text{cyl. diam.}}{\text{height}}\right)=2270\ (0.778+0.111)=2220\times0.889=$$

2018 lb. per sq. in.

$f'_d=10\%$ of 2018=202 lb. per sq. in.

The steel ratio, p_d, is equal to $\frac{A}{b_1a}$

For computing the ultimate unit shear observed during the tests, $v'=\frac{V'}{b_1jd}$

For computing the ultimate unit shear from tensile strength of concrete and elastic limit or yield point of the web steel,

$$v'=f'_d+f'_s\frac{A}{b_1a}=f'_d+f'_sp_d$$

The following table (Table V) shows the results obtained by this method:

TABLE V

Beam	Steel ratio Stirrups	Steel ratio Bent rods	Unit Stress Stirrups lb./in.²	Unit Stress Bent rods lb./in.²	Computed shear lb./in.²	Observed shear lb./in.²	Ratio of observed shear to computed shear
I*	0	0	0	0	202	89	____
II	0.00172	0	40230	0	271	266	0.98
III§	0	0.00179?	0	66350?	320?	288	0.90?
IV	0.00170	0.00500	40230	28400	412	423	1.02
V	0.00170	0.00585	40230	28400	437	437	1.00

*Probably failed by bond before the ultimate strength in diagonal tension was reached. Unit bond stress at time of failure was approximately 165 lb. per sq. in., and the unit tensile stress in the steel was approximately 38,000 lb. per sq. in.

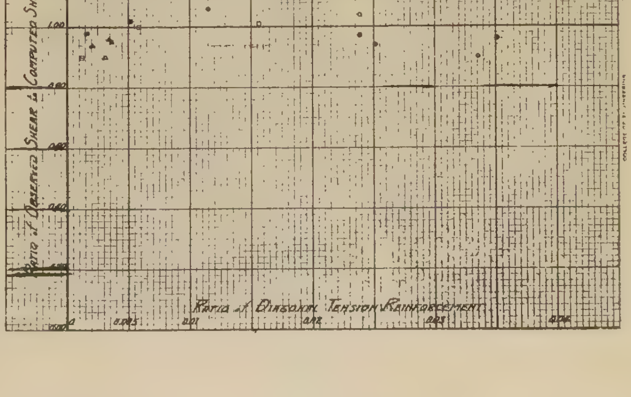
§All web steel web bent up in one plane.

In beams IV and V, it was assumed that the rods were bent at an angle of 45 degrees and that the unit stress in these bent rods would be equal to the unit stress in the vertical stirrups times the cosine of 45 degrees.

Computed shear for beams IV:

$$v'=202+0.0017\times40{,}230+0.0050\times28{,}400$$
$$=202+68+142=412\text{ lbs. per sq. in.}$$

In the curve sheet following, the ratios of observed to computed unit shears have been plotted as ordinates with the steel ratios of the diagonal tension reinforcement as abscissae.



In each set of beams having vertical stirrups and bent rods, the steel ratio of the bent rods has been multiplied by the cosine of 45 degrees and then added to the steel ratio of the vertical stirrups. These plotted values were tabulated in Table VI to obtain averages.

TABLE VI

Steel Ratios of Diagonal Tension Reinforcement and Ratios of Observed to Computed Unit Shears

	Withey		Slater		Braune and Meyers	
	Steel Ratio	Shear Ratio	Steel Ratio	Shear Ratio	Steel Ratio	Shear Ratio
	0.0037	0.95	0.0335	0.90	0.0017	0.98
	0.0034	0.96	0.0251	0.94	*0.00126	0.90?
	0.0031	0.90	0.0156	1.01	0.0052	1.02
	0.0070	1.14	0.0082	1.11	0.0058	1.00
			0.0351	0.95		
			0.0239	0.97		
	0.0022	0.94	0.0155	1.18		
	0.0020	1.13	0.0087	1.26		
			0.0239	1.04		
			0.0115	1.06		
Average		1.00		1.04		0.98
Average omitting *						1.00

Average of three sets=1.01.

British Research Board Investigates Fire Resistance of Concrete

By A. C. BLACKALL

Resistance of buildings to fire depends upon a wide variety of factors both in their design and in the materials of which they are constructed. Despite the large amount of experimental work that has been done on the problem both in the United States and the United Kingdom, the results have been conflicting.

Consequently the British Building Research Board of the Department of Scientific and Industrial Research undertook a series of experimental investigations. The experiments were carried out by Dr. R. E. Stradling, technical chief of the Building Research Board, and F. L. Brady in the years 1922 to 1924 at the Bradford Technical College. The results, some of which have been checked since that date, have recently been published by the Government Stationery Office as a "Report on Fire-Resisting Construction." The long delay in publication has been largely due to the fact that the authors have been transferred to the new Building Research Station, where the most promising mixtures of cements have been under observation for the last two years, and results will be reported upon the completion of five years' experience.

The effects of moisture and of heat are of great importance in connection with the resistance of artificial products to fire. They are observed in bricks, terra cotta, lime, cements and concretes. For example, set portland cement expands with heat up to 100 degrees Centigrade, when it loses water, and on continued heating at that temperature contracts more than it had expanded. With rising temperatures the contraction continues as water of hydration is given off, an effect which in cements containing free slaked lime is especially marked between 400 and 500 degrees Centigrade, when the free lime is dehydrated into quicklime, and causes considerable further shrinkage, usually accompanied by very severe cracking, and ultimately followed by expansion. In ordinary cement the lime is formed and disseminated throughout the mass on the hydration of the cement, and the quicklime left after it has been dehydrated by heat may be rehydrated subsequently, if it is moistened, producing an expansion and disintegration of the mass, which may occur and become apparent only some days after the occurrence of the fire. Similar considerations apply to concrete, in virtue not only of the cement employed in its preparation, but also of the material chosen for the aggregate.

The Board recognizes that no material is absolutely fireproof, and that the best to be hoped for is to reduce the injury inflicted by heat to such an extent as will avoid failure under full load during or after the fire, and to make the damage readily evident and easily repaired. The authors' experiments have been principally directed to investigating the materials that can be used to combine with the lime liberated in portland cement when it sets, and the proportions in which a sufficiently complete combination may be obtained without an undue present or future reduction of strength, and even with some increase on exposure to moisture after cooling from a high temperature. Such materials are known as puzzolanic, and among those that have given promising results in the preparation of fire-resisting cements are certain varieties of clinker, baked clay, spent shale, and granulated slag when used in conjunction with suitable fine aggregates. The rate at which even the most active puzzolanic material combines with lime becomes very slow after about a week, and both fine grinding and plenty of water are necessary to enable the reaction to be carried as far as possible while the puzzolanic material is still active. In the preparation of concrete, strength and permeability are decreased by excess of water, but it is said that the amount of water actually used in present practice is sufficiently greater than would be necessary for producing maximum strength to provide the excess of water necessary for promoting the puzzolanic reaction.

The investigators give details both of the mixtures that have been successful in the experiments and of those that have not, and claim that, as a result, they show the possibility of making a fire-resistant concrete within the practical limits required in constructional work. Experiments still in progress show, moreover, the probability that some of the mixtures will exhibit a continuing increase of strength for a time, of which the period is not yet defined, but which seems, at any rate, to exceed two years. With concrete, indeed, the difference between ordinary mixes and those now suggested as resistant to fire is very great. The former lose practically all their strength on exposure to heat and do not recover it; whereas the latter lose only one-half their strength, and on subsequent exposure to water recover it gradually to an extent that it is hoped may be found to bring it ultimately up to at least its original figure.

A difficulty that, as yet, these fire-resisting concretes have not solved is their association with steel. Like ordinary concrete, they shrink under heat, while the steel expands, and with ordinary conditions of design the concrete cover must flake off under fire and leave the steel surface exposed to the heat. This difficulty is being made the subject of further investigation, and there seems to be hope of ultimate success.

Horticultural Hall of Concrete

Out of a mass of timber shuttering, to hold thousands of tons of liquid concrete, is gradually emerging the skeleton of the new Horticultural Hall in London.

The structure contains many features of interest, both from the architectural and the engineering points of view. The main hall consists of a central bay, 72 feet in width and 150 feet long, on either side of which is an aisle about 26 feet to 28 feet in width.

Spanning the central bay are concrete arches, 58 feet high from the ground floor.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit, Michigan.

Twenty-fifth annual convention, Book-Cadillac hotel, Detroit, Mich., Feb. 12th to 14th.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Construction Council; Dwight L. Hoopingarner, Executive, 28 W. 44th St., New York City.

American Engineering Standards Committee; Dr. P. G. Agnew, Secretary, 29 W. Thirty-ninth St., New York City.

American Road Builders' Association; Miss E. A. Birchland, Secretary, 29 W. Thirty-ninth St., New York City.

1929 convention and road show, Cleveland, Ohio, Jan. 14th to 19th.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 W. Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

Associated General Contractors of America; D. H. Sawyer, Secretary, 1150 Munsey Bldg., Washington, D. C.

Associated Metal Lath Manufacturers; Wharton Clay, Commissioner, 123 W. Madison St., Chicago.

Association of Cast Stone Manufacturers; Frank M. Brooks, Secretary, Pasadena, Calif.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Concrete Products Association; F. O. Matthiessen, Secretary, 644 Drexel Building, Philadelphia, Pa.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Iowa Concrete Products Association; R. L. Gavin, Secretary-Treasurer, 1002 Hubbell Bldg., Des Moines, Iowa.

National Association of Building Trades Employers; A. W. Dickson, Executive Secretary, 2226 Builders Building, Chicago, Ill.

National Association of Builders' Exchanges; Earl F. Stokes, Secretary, 15 E. Fayette St., Baltimore, Md.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Housing Association; Lawrence Veiller, Secretary and Director, 105 E. Twenty-second St., New York City.

The National Lime Association, Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N.W., Washington, D. C.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 432 Munsey Building, Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Building, Cleveland, Ohio.

Northwest Concrete Products Association; F. R. Zaugg, Executive Secretary, 803 Seaboard Building, Seattle, Wash.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.

Portland Cement Association; William M. Kinney, General Manager, 33 W. Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Building, 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer, 3115 Plankinton Arcade, Milwaukee, Wisconsin.

Annual Convention, Plankinton Hotel, Milwaukee, Jan. 10th and 11th.

Mixer Musings

Reported by "Joe"—The Mixer Boss.

Slump Testers Absent When Help Is Needed

Federal prohibition authorities at Portland, Oregon, recently employed a concrete mixer to destroy liquor bottles, as shown. An official canvass has shown that not one slump tester was in attendance. Untold serious consequences might ensue through such lack and if the majority of slump testers desire it, CONCRETE will begin action immediately with federal authorities to see that this vital error does not occur again.

Ambition and a Concrete Swimming Pool

By CHARLES E. BABBS

Office Boy Staff, Main Office, Portland Cement Association

(In Two Parts—Part Two)

Construction on the swimming pool was started at once, for they planned to open the pool on the twentieth of June. The fact that both of the boys had money in the bank made this possible. Saturday afternoons and after school both boys were on the job helping the workmen.

The twentieth of June was drawing near and the boys were anxious for the opening day to come. At last! That day was bright and hot, an ideal day for a swim! The pool was extremely crowded and it stayed that way all summer. Ted and Ray were very much pleased. Their folks were proud of them also, for they were swiftly and steadily making their bank account grow.

When September came around they were ready for college and had plenty of money for expenses.

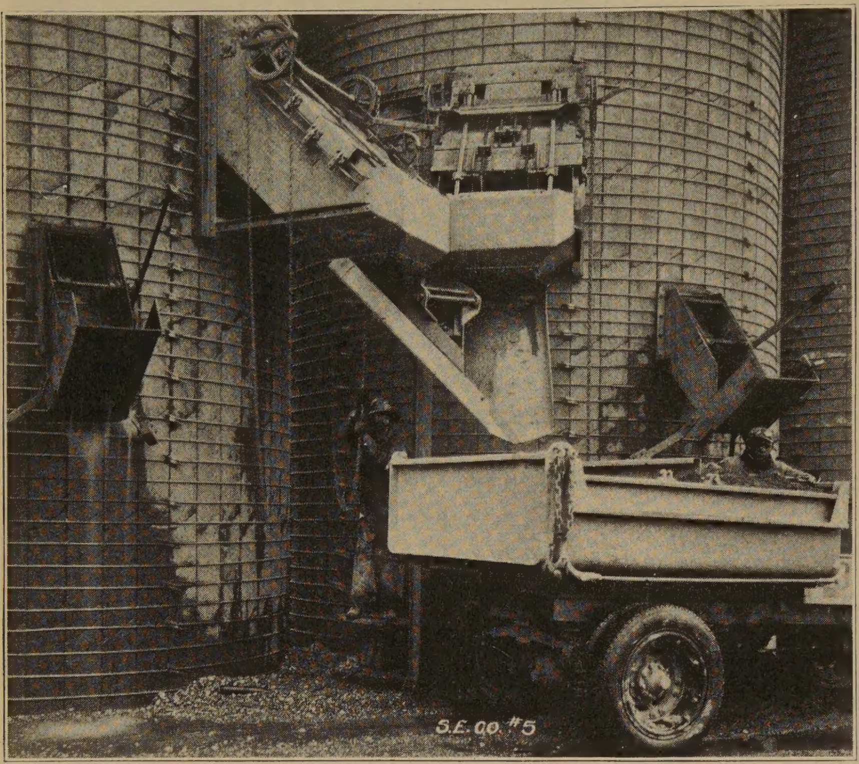
They spent happy summers operating the pool and giving exhibitions. The winters were enjoyed at college. And when they were awarded their degrees in Civil Engineering they had to thank their Concrete Swimming Pool!

Joe, the Mixer Boss.

New Equipment and Materials

New Superior Batchmeter Effects Clean Discharge

The batchmeter shown has been developed by the Superior Engineering Co., Warren, Ohio, for batching from silos. The upper gate is absolutely interlocking with the lower, making it impossible to open either one and not the other, the manufacturer states.



A space of 4 ft. 8 in. is required by the device, from the discharge point in the silo to the point where the device discharges into the truck. In an installation where 2 batchmeters are opposite each other and meet at the discharge point, a batching speed of 6 batches per minute is said to be possible. Four to five batches per minute are claimed for other installations.

The operator uses one control—a large chain wheel—which is operated from the ground.

Removable Joint Plates Heltzel Product

Removable joint plates for building expansion and contraction joints in concrete pavement are a new product of the Heltzel Steel Form & Iron Company, Warren, Ohio.

In the Heltzel system of center joint construction, V-shaped removable joint plates are used with expansion bars and pedestals. The pedestals remain permanently beneath the surface of the concrete. The joint plates are supported on pedestals and brought to alignment. The expansion bars are then inserted. After the surface has been belted and the concrete taken its initial set, the expanding bar is removed and the V-shaped plate collapsed, withdrawn and used over again.

The joint is finished by a tool which rounds the edges and a filler used. The joint plates may be reused as many times as desired.

Products Plant Pulley of Semi-Steel

The W. A. Jones Foundry & Machine Company, Chicago, is now manufacturing a semi-steel pulley said to materially improve the old type cast iron pulley without increasing the cost. The semi-steel moulded pulley is a combination of steel and iron. It is close-grained and free from defects, according to the manufacturers.

Paris Transit Mixer

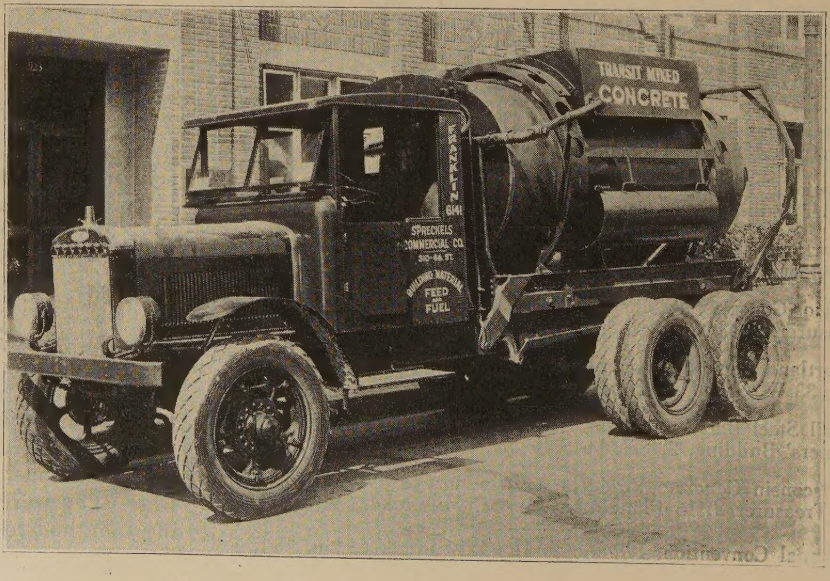
Transit Mixers, Incorporated, San Francisco, Calif., has placed on the market the Paris transit mixer, designed to mix accurately proportioned concrete en route to the job, without segregation, it is said.

The manufacturers consider this not as a piece of equipment for central mixing plants, but as a mixing plant on wheels in itself.

The cylindrical steel drum receives the pre-measured batch of dry aggregate and cement through the funnel end while the drum is rotating, effecting a dry mix. The water tanks at either side are filled, one with the correct amount of water to be used in mixing the concrete, the other tank for flushing the drum after the concrete is poured.

The funnel end at the rear serves to pour the concrete into the forms, skips, or other equipment. The mixer barrel is elevated by means of any standard make hoist.

A gear-drive power "take-off" enables the driver to start mixing either en route or at the job by the operation of controls at his side. The mixer is said to fit any standard make of truck of 2½ tons or over.



RAIL STEEL

for concrete reinforcing

HIGH strength and toughness the balanced physical properties of rail steel reinforcing bars are the result of a scientifically controlled rolling process developed by twenty years' combined research and experience and shared by each member of the national association representing this industry.

RAIL STEEL BAR ASSOCIATION
BUILDERS BUILDING, CHICAGO

MEMBERS

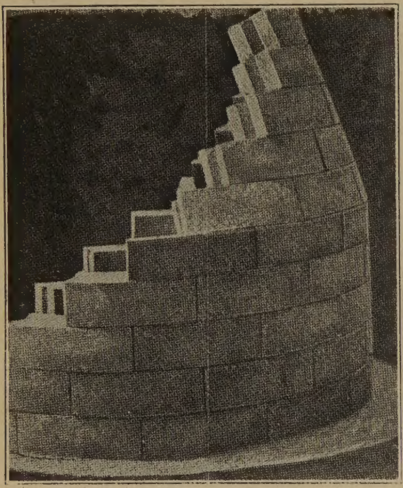
BUFFALO STEEL COMPANY, TONAWANDA, N. Y.; BURLINGTON STEEL COMPANY, HAMILTON, CANADA; CALUMET STEEL COMPANY, CHICAGO, ILL.; CANADIAN TUBE AND STEEL PRODUCTS LIMITED, MONTREAL, CANADA; CONNORS STEEL COMPANY, BIRMINGHAM, ALA.; DANVILLE STRUCTURAL STEEL COMPANY, DANVILLE, PA.; FRANKLIN STEEL WORKS, FRANKLIN, PA.; LACLEDE STEEL COMPANY, ST. LOUIS, MO.; MISSOURI ROLLING MILL CORPORATION, ST. LOUIS, MO.; POLLAK STEEL COMPANY, CINCINNATI, OHIO AND WEST VIRGINIA RAIL COMPANY, HUNTINGTON, W. VA.

New Equipment and Materials

Choice of Machines for Producing Manhole Block

In the field of concrete manhole block there have been developed several excellent types. Two of these, known as the "Anchor" and the "Universal" are produced on machines made by those divisions of the Consolidated Concrete Machinery Corporation.

The laying up of both walls is primarily similar. As soon as the concrete floor and footing are in, a complete course of block is laid in a circle, using fairly stiff portland cement mortar. If the block are made with grooves on both ends, the core holes formed by adjoining grooves in block ends are filled with soft grout, puddled with a trowel handle.

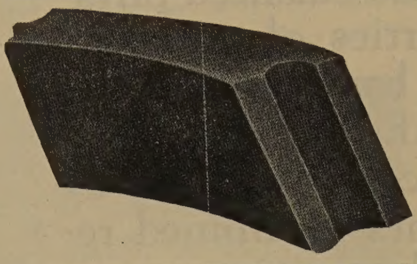


As each course is laid, the mortar joints on the outside are struck off, but the projecting mortar on the inside is left hanging until the structure is built up to the point of "drawing in." These inside joints are then rubbed down with a gunny sack or cement sack to produce a smooth inside surface.

At this point of "drawing in" to permit setting of a standard frame and cover at the street grade, the two types differ. When using Anchor block, a course of bevel block is laid, followed by standard block. Each course is built of one less unit than the course below it. When the top is reached, a course of reverse bevel block (the high side of the block being on the inside of the circle) is laid to provide a level seat for the cover frame. If reverse bevels are not used, a ring of stiff mortar may be placed to level up the top course.

The standard Anchor block are 5½ in. high, 5¾ in. thick and approximately 16 in. long, curved to fit a 4 ft. inside diameter. Twelve block are used to each course. This type bevel block is sloped, the thicker side being, of course, the outside, as shown in the illustration of the partly completed manhole.

The illustration of the single unit accompanying this description depicts the Universal bevel or batter block. One course of these will draw a 30-in. circle into 24 in. while 2 courses will draw a 36-in. circle to 24 in., 3 courses to a 42-in. circle, and so forth.



Ransome Machinery Puts Out 13-E Mixer

The 13-E is a new, medium size paver put out by the Ransome Concrete Machinery Company, Dunellen, New Jersey, to supply a fast, quality paver between the Ransome 27-E and 10-E, according to an announcement. The paver, it is said, is well adapted for city paving, alleys, small country roads, sewer work and similar jobs.

The Ransome standard all-steel mixing drum is used, with locomotive tires for tracks, flanged car wheels for rollers with Timken bearings. Other specifications include a full length crawler, together with a power loader and automatic water tank.

The water tank is 24 in. in diameter and 32 in. high set vertically. It has an inside adjustable displacement tank and will measure accurately, it is claimed, any amount of water between 8 and 25 gallons. Adjustment is made by a handwheel with an indicator and scale. The claim is made that when once set the tank will deliver that amount each time regardless of the grade that the paver may be working on. A gauge glass is provided.

INDUSTRIAL LITERATURE

More on Celite

The use of the admixture *Celite,* marketed and manufactured by the *Celite Products Company,* is the subject of a 16-page bulletin, *No.* 339, just off the press.

The bulletin describes, by word and illustration, the functions of Celite in improving workability in the mix and how this in turn affects the uniformity, watertightness, and other factors of the finished product. The bulletin includes also a discussion of water-cement ratio control and the use of Celite when the former is practiced.

Incor On the Job

Facts about *Incor,* high early strength cement, are presented in a 4-page folder published by the *International Cement Corporation* and entitled *"Underpinning a Mountain."*

The publication deals with the use of the cement in the construction of the Moffat tunnel through the Rocky Mountains and gives the specification for Incor cement.

On the third page is found a list of jobs in which the product has been used, classified, as railways, industrial, products, highways, and public service.

Effect of Concrete Conduit

A report dealing with the factors involved in the corrosion of lead cable sheaths has been published by the *Murray Conduit Systems,* New York City, under the title, "Twentieth Century Mythology."

The contents of this publication, addressed to the distribution engineer, disproves the fallacy of the deleterious action of concrete conduit upon lead cable sheaths, summarized in the statement, "...Extensive field tests have shown that seasoned concrete, in which the alkalinity has been neutralized by the carbon dioxide in the air or otherwise, has no effect on lead even when wet. Concrete 28 days old is perfectly safe."

Notes from the Field

Ryerson Acquires Sanderson Co.

Joseph T. Ryerson & Son, Inc., have acquired the business of the *E. P. Sanderson Company,* Cambridge, Mass.

The Ryerson Company have been operating on leased property at 675 Concord Ave., Cambridge, since May 1, 1926. This move will give them a large increase in plant facilities and tonnage.

Erie Construction Office

The Erie Steel Construction Company has opened its own office in Chicago for the selling and servicing of Erie Aggremeter plants and Erie clamshell buckets.

O. H. Watson, engineer, is in charge of the office, which is located at 231 Engineering Building, 205 West Wacker Drive.